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Dopady makroekonomických determinantů na úvěry v selhání čínských komerčních bank

Effects of Macroeconomic Determinants on the Non-performing Loans of Chinese Commercial Banks

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1. Introduction
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Content

1 Introduction

In recent years, the non-performing loans ratio of Chinese commercial banks has been rising, which not only reduces the asset quality level and profitability of commercial banks, but also weakens the ability of commercial banks to lend money and support the market economy. Chinese financial system is a kind of indirect financing based on banks. It is supported by the direct financing of issuing stocks and bonds. From the composition of Chinese financial system, it can be known that the non-performing loans ratio is a very important indicator of credit risk monitoring.

The monitoring of credit risk is an important part of macroprudential analysis, which focuses on the evaluation of systemic risk. Systemic risk is considered to be endogenous due to common exposures of financial institutions to macroeconomic risk factors and related interactions between the real economy and financial systems (Borio, 2003).

Once the credit crisis of Chinese commercial banks occurs, market liquidity might be frozen, economic growth might slow down or become negative, and the real economy might decline rapidly. Like Japan in the 1990s. Therefore, the problem of non-performing loans of commercial banks is a major issue that China needs to pay enough attention to. The research of this issue is of a great importance to the development of Chinese banking, financial markets and real economy.

The aim of this thesis is to research the impact of selected macroeconomic factors on aggregate credit risk of China. Although there are many ways how to measure credit risk, this thesis uses the non-performing loans ratio of commercial banks as an indicator of aggregate credit risk. Therefore, the aim of this thesis could also be seen as investigating the impact of macroeconomic factors on the non-performing loans ratio of Chinese commercial banks. The data selected in this thesis is from the first quarter of 2004 to the fourth quarter of 2018.

The structure of the thesis is as follows: In the second chapter, the non-performing

loans ratio of Chinese commercial banks is described. It includes the definition of non-performing loans and non-performing loans ratio, the development of Chinese non-performing loans and non-performing loans ratio, and the impacts of the problem loans on the Chinese real economy.

The third chapter explains in the theoretical way the impact of macroeconomic factors such as economic growth, inflation, unemployment rate, and monetary policy on the non-performing loans ratio. Moreover, it identifies the most representative and measurable indicators to approximate these macroeconomic determinants for the purposes of empirical analysis. The theoretical background is based on the economic theory, the theory of money and banking, and the existing empirical literature.

The fourth chapter represents the empirical part of this thesis. We have collected the time series data from the first quarter of 2004 up to the fourth quarter of 2018, and have employed an Autoregressive Distributed Lag Model bound test approach to cointegration to examine the long and short-run impact of the macroeconomic variables on the non-performing loans ratio. There are various methods for examining the existence of a long-run relationship between the variables of interest: e.g. Engle and Granger (1987) and Johansen (1988) are the most widely adopted approaches. However, we follow the Autoregressive Distributed Lag Model bound test approach due to the favorable features of this technique compared to the other conventional approaches, as it is discussed in greater detail in this chapter.

The last part of the thesis provides conclusions and policy recommendations, which are drawn based on the estimated empirical results and theoretical knowledge.

2 Theoretical Background of Problem Loans

The main content of this chapter is to introduce the concept of non-performing loans ratio (NPLR) and Chinese monitoring methods and solutions for non-performing loans (NPLs). Moreover, the impact of NPLs on Chinese economic development is described.

2.1 Conceptual Definition of Non-performing Loans and Non-performing Loan Ratio

A NPLs is a sum of borrowed money upon which the debtor has not made the scheduled payments for a specified period. Although the exact elements of non-performance status vary, depending on the specific loan's terms, "no payment" is usually defined as zero payments of either principal or interest. The specified period also varies, depends on the definition from legislation. Generally, however, the period is 90 days or 180 days overdue. Several international financial authorities offer specific guidelines for determining NPLs. For example, The European Central Bank (ECB) requires asset and definition comparability to evaluate risk exposures across euro central banks. The ECB specifies multiple criteria Based on which loan could be classified as NPLs when it performs stress tests on participating banks.

In 2014, in a comprehensive assessment, the ECB defined loans as nonperforming if they met any of the following criteria: (i) are 90 days past due, even if they are not defaulted or impaired, (ii) are impaired with respect to the accounting specifics for U.S. GAAP and International Financial Reporting Standards (IFRS) banks, (iii) are in default according to the Capital Requirements Regulation (ECB, 2014).

The International Monetary Fund (IMF) also sets out multiple criteria for a NPLs classification. In 2005, the IMF defined NPLs as following: (i) debtors has not paid interest and/or principal payments in at least 90 days or more, (ii) interest payments equal to 90 days or more have been capitalized, refinanced or delayed by agreement,

(iii) the payments have been delayed by less than 90 days, but come with high uncertainty or no certainty that the debtor will make payments in the future (IMF, 2019).

Banks depend on borrowers to maintain their scheduled loan repayments as a major source of revenue. When a borrower has not made regular payments for at least 90 days, the loan is considered an NPLs. The NPLR is the ratio of the amount of NPLs in a bank's loan portfolio to the total amount of outstanding loans the bank holds. The NPLR measures the effectiveness of a bank in receiving repayments on its loans (Bizfluent, 2018).

$$\text{non} - \text{performing loans ratio} = \frac{non - performing\ loans}{total\ loans} \cdot 100\ (\%)$$

2.2 Credit Risk of Commercial Banks

Since 1930, the credit risk assessment methods have gone through (i) the traditional credit risk assessment phase, (ii) the statistical analysis phase, (iii) the option theory analysis phase, and (iv) the computer-based artificial intelligence phase (Baidu, 2017).

Ke and Zhou (2005) comparatively analyzed the domestic and international credit risk assessment methods, and pointed out the advantages and disadvantages of various evaluation methods, which brought reference to the evaluation of credit risk of commercial banks in China. Xia (2007) comprehensively summarized and organized the theoretical background of risk management, credit risk measurement methods and research status at home and abroad, focusing on the improvement and empirical analysis of risk measurement methods, using the financial information disclosed by listed companies. A credit evaluation index system for listed companies was established, and a fuzzy neural network method for credit risk measurement was proposed. The BASEL system represents framework for banking regulation and supervision (including monitoring and management of risks). According to the original intention of the New Capital Accord of BASEL II, capital requirements are closely linked to risk

management. The New Capital Accord is a complete regulatory framework for the capital adequacy ratio of the banking industry. The credit risk internal rating method is the core, which enhances the bank's risk sensitivity and ability to cope with risks. Chava (2004) used the risk rate model in the observations of financial institutions and used monthly frequency data to find that the ability to predict bankruptcy is significantly improved when using monthly frequency data, as market efficiency is more consistent with public information.

Analysis of bank credit risk with NPLR: NPLR is the main reason for the fragility of the banking system. A high NPLR threatens the stability of the entire banking system. Minsky (1964) analysis is based on a summary of the long-term volatility of capitalist prosperity and recession, pointing out that the seeds of the financial crisis were sown during the economic boom. During the economic upswing, the bank's loan evaluation criteria have become more and more accommodative. while companies used the loose and favorable credit environment to actively borrow. The existence of a business cycle will induce companies to operate in high debt. At the beginning of a new cycle, most companies are subsidized. With the further prosperity of the economy, the market is in a good atmosphere, and the company expects the income to rise. At this time, the company will choose to expand the loan, and the speculative enterprises and Ponzi enterprises will increase rapidly. In this way, the proportion of the latter two types of borrowers with high risk among borrowers is increasing. However, the capitalist economy will inevitably go into recession. Any event that interrupts the flow of credit funds into the production sector will cause an increase in the probability of default. It will also cause the increase in the NPLR of commercial banks and even lead to bankruptcy, the bankruptcy of commercial banks will further extend the influence to the entire financial system. Li and Xiang (2008) believe that credit risk is the main risk faced by Chinese commercial banks, because the business of each bank is basically loan provisioning, bill discounting, interbank lending and other loan-type businesses and government bonds. The higher the NPLR, the greater the materialization of credit risk

of the bank, because NPLR is ex-post indicator of credit risk.

Salas and Saurina (2002) studied the differences in the influencing factors of NPLR between Spanish commercial banks and savings banks, using Gross Domestic Product (GDP) growth, corporate and household debt, branch expansion, portfolio composition, scale, net interest rate of return, capital adequacy ratio as the influencing factors, however, there are significant differences between commercial and savings banks, which confirms the relevance of the institutional form in the management of credit risk.

2.3 History of Non-performing Loans Supervision and Management of Chinese Commercial Banks

2.3.1 Chinese Commercial Bank´s Non-performing Loans Classification Method

Financial and insurance enterprise financial system (documents promulgated by the Ministry of Finance in 1993) and *Loan General Rule* (defined by the People's Bank of China in 1995) both classified commercial bank´s loans into four types: pass, past-due, idle and loss. A pass loan means that the borrower can perform the contract and has been able to repay the principal and interest normally. There is no negative factor affecting the timely and full repayment of the principal and interest of the loan. The bank has sufficient confidence that the borrower will repay the principal and interest of the loan in full and on time. Past-due loans Refers to the portion of the loan that has not been paid off within the contractual repayment period (excluding idle and loss loans). Idle loan refers to loan that is still not repay after 90 days, according to the relevant regulations of the Ministry of Finance. A loss loan is a loan that confirms that it has been unable to recover according to the borrower's solvency or legal requirements. The latter three types of loans are considered as NPLs (Baidu, 2017).

When the Chinese economy had developed to a certain stage, the four-level classification method has no longer met the needs of its economic development. The *Loan Classification Guidelines* and the *Loan Risk Classification Guidelines* issued by

the People's Bank of China in 1998 and 2001 (respectively) classify bank loans according to their inherent risks as pass, special-mention, substandard, doubtful and loss. The pass loan was defined the same as before the reform. Special-mention loan means: although the borrower has the ability to repay the principal and interest of the loan, there are some factors that may adversely affect the repayment. If these factors continue, the borrower's ability to repay will be affected, and the probability of loan loss will not exceed 5%. The substandard loan is expected to result in a loss of interest for the lender, because the borrower is unlikely to be able to pay back the loan for some reasons completely. A lender will occasionally agree to a substandard loan even though some revenues will be lost, usually on a substandard loan, there is no loss of principal and only some interest will be lost, the probability of loan loss is between 30% and 50%. Doubtful loans are defined as following: the borrower is not able to repay the principal and interest of the loan in full. It will definitely cause some losses to bank. However, there are some factors such as borrower's restructuring, mergers, collateral processing and pending litigation, the amount of potential loss is uncertain; in general, the probability of loss in the case of doubtful loan is between 50% and 75%. Loss loan refers to the borrower loses all the principal and interest of the loan. No matter what measures are taken and what procedures are followed, the loan is destined to be lost, from the perspective of the bank, there is no meaning and necessity will be retained as bank assets in the bank's balance sheet. Such loans should be written off immediately after fulfilling the necessary legal procedures, and the probability of loan losses is 75% - 100%.

The last three categories are considered as NPLs, and the five-category classification system is recognized as the standard in the world. It is used e.g. by the World Bank, the International Monetary Fund, or the Organization for Economic Cooperation and Development. The NPLs data published by these institutions are reported using a five-level classification method (Baidu, 2017).

2.3.2 Supervision and Management of Non-performing Loans

The first thing to introduce when discussing banking supervision is the establishment of the China Banking Regulatory Commission (CBRC), which was established in 2003. Compared with the comprehensive supervision of the People's Bank of China over the financial market, the CBRC mainly supervises and manages the Chinese banking industry. The main duties of the CBRC can be divided into three categories. Firstly, the formulation of policies. The CBRC has the competence to formulate relevant banking regulatory policies, and introduce various rules and regulations that are in line with the constitutional requirements, and require the national banking industry to implement them. Secondly, banking supervision, usually in the form of on-site inspections and off-site inspections, carries out risk supervision on the daily operations of national banking institutions. Thirdly, it publishes news. On the one hand, it immediately publishes about domestic and international financial development, financial reforms, and finance, on the other hand, it regularly publishes quarterly and annual *Main business supervision indicators*, *Banking supervision statistics indicators* and *Commercial indicators of major indicators of commercial Banks* and other statistical documents (CBRC, 2003).

The second major measure for managing NPLs is to set up four asset management companies to handle NPLs of commercial banks. In 1999, the Chinese government set up four asset management companies to help the four major state-owned banks solve huge volume of NPLs. *Huarong Asset Management* Company was responsible for acquiring the NPLs of Industrial and *Commercial Bank of China*, and *Oriental Management Company* was responsible for acquiring NPLs of *Bank of China*. *Cinda Asset Management Company* was responsible for acquiring NPLs from *China Construction Bank*, and *Great Wall Asset Management Company* was responsible for acquiring NPLs from *Agricultural Bank of China*.

Since the establishment of the four major asset management companies in 1999,

they have taken three major measures on the NPLs of the Bank of China:

From 1999 to 2001, the total of NPLs of the four major banks of the four state-owned banks totaled 1,393.9 billion yuan, all of which were divested by asset management companies.

During the period of 2004-2005, the NPLs of China Construction Bank, Bank of China and Industrial and Commercial Bank of China totaling 900 billion yuan were divested by the four major asset management companies, resulting in a decline of the NPLR in 2005 from 12.4% in the first quarter to 8.61% in the fourth quarter.

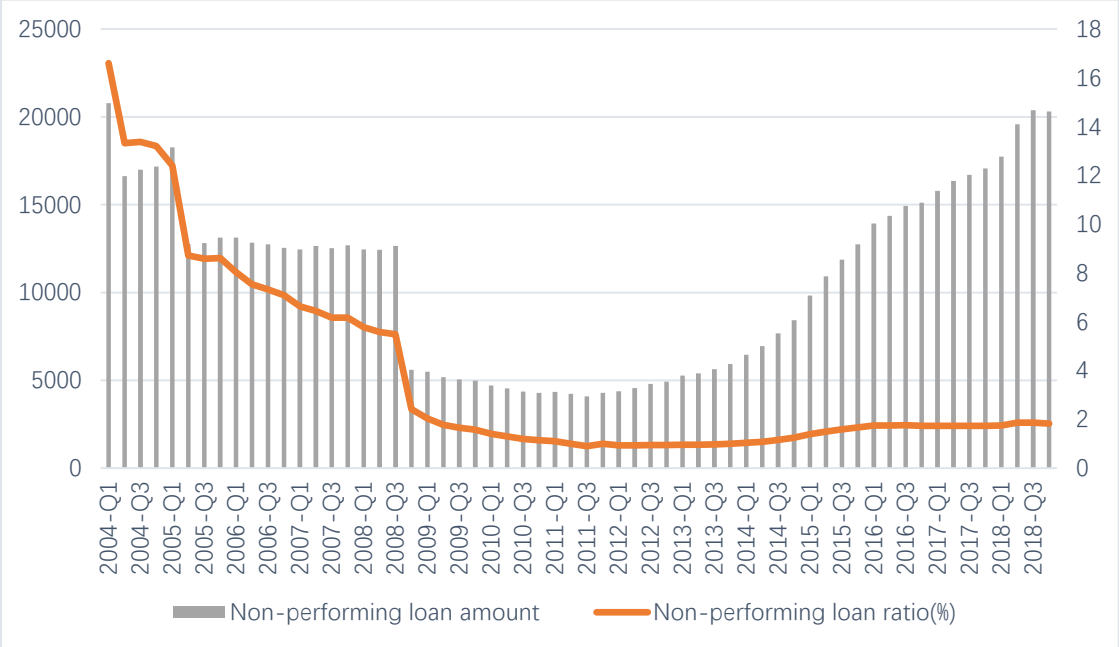
In 2008, the four major asset management companies divested a total of 815.7 billion yuan of NPLs from the Agricultural Bank. In the fourth quarter of 2008, Chinese NPLR fell to 2.42%. Therefore, in addition to the impact of macroeconomic factors, the bank's own operations and banking regulatory factors, the four major asset management companies played an important role in the decline of the NPLR of Chinese commercial banks during the period 1999-2008. However, their ability to reduce NPLs still depends on the degree of business cycle, which also shows that the macroeconomy plays a key role in the increase and decrease of the NPLR of the Chinese banking industry (Xue, 2018).

2.4 Development of Chinese Non-performing Loans and Non-performing Loans ratio

Between 2004 and 2010, after experiencing the reform and development of the real economy, financial reform and development, the disposal of NPLs of commercial banks by the four major asset management companies, and the supervision and governance of the CBRC and other institutions, the downward trend of NPLR of Chinese commercial banks is obvious, as shown in Fig 2.1. The total amount of NPLs of Chinese commercial banks was 2.0776 trillion yuan, which appeared in the first quarter of 2004. In the fourth quarter of 2008, the total amount of NPLs has fallen to 560 billion yuan, showing a rapid decline. Then began to show a gradual decline. In the

third quarter of 2011, it reached its lowest level of 407.8 billion yuan, and then began to increase gradually. By the third quarter of 2018, NPLs reached 2.0373 trillion yuan, closing to the highest level in the first quarter of 2004.

Figure 2.1 Chinese Total NPLs (in bn. of yuan) and NPLR (in %) in 2004Q1-2018Q4



Source: China Statistics Network (2018), self-elaboration

The NPLR of Chinese commercial banks also showed a very obvious downward trend in 2004-2008. After that, the rate of decline slowed down, reaching a historical low of 0.9% in the third quarter of 2011, and then rising year by year, but the trend is very slow. Because the base of total loans was large, the NPLR did not return to the high level of first quarter of 2004.

2.5 The Impact of Non-performing Loans of Commercial Banks on Chinese Macroeconomy

The problem of NPLs will not only affect the bank's asset quality and profitability, but also could lead to the outbreak of the banking crisis, and the real economy will be seriously affected. This thesis will discuss the impact of NPLs on the macro economy from two aspects. Firstly, using the deposit money creation mechanism of commercial

banks and the currency creation mechanism under the central bank system, how to influences the macroeconomy from the perspective of Western Economic Theory. Secondly, from the perspective of financial fragility, use the mechanism of the stability of the financial system to discuss this issue.

2.5.1 Non-performing Loans and the Creation Mechanism of Modern Currency

From the perspective of modern currency creation mechanism, due to the emergence of NPLs, commercial banks need to increase the *provision coverage ratio*[1], the increase in provision coverage means that banks must make a portion of the money from the deposit reserve to supplement the bad debt reserve, so that the *deposit reserve ratio*[2] of commercial banks will be reduced, even if the bank does not adjust these two ratios, the bank's deposit creation capacity will weaken. At the same time, the ability to create money under the central bank system will also be affected, eventually reduce the money supply in financial market. When the supply of funds in the financial market is reduced, the opportunity cost of investors will increase. In this case, the company may give up investment in some projects.

When the money supply of the whole country is in short supply due to the generation of NPLs, that is, when the entire social money supply is insufficient to support the normal operation of the entire economy, the monetary authorities often adopt a method of increasing the money supply to maintain the safety of the banking system. Although the money supply in the market has increased, the real economy has not developed correspondingly, that is, the supply of goods has not changed, which is likely to cause price increases, once a country's currency depreciates. Once a country's

[1] It is the ratio of provisioning to gross non-performing assets. The provision coverage ratio (PCR) gives an indication of the provision (generated from profit) made against bad loans. Higher the PCR, lower is the unexposed part of the bad debts.

[2] Also known as Cash Reserve Ratio, it is the percentage of deposits which commercial banks are required to keep as cash according to the directions of the central bank.

currency depreciates, the country is prone to the *first-generation financial crisis*[3] (Xavier, 2015).

In the theoretical framework of economics, the size of the four indicators of consumption, investment and net export together determine the size of a country's GDP. Combined with the abovementioned analysis, the existence of NPLs will reduce the absolute value of these four indicators, and conclude that the GDP will inevitably decrease.

2.5.2 Non-performing Loans and Financial Vulnerability

Krugman (2000), by studying the occurrence of the financial crisis in Southeast Asia and deriving the theory of the third generation of currency crisis, this theory elaborates an important concept: financial excess. When financial institutions are unable to enter the international market, excessive investment demand does not lead to large-scale over-investment, but the rise in market interest rates. When financial institutions are free to enter and exit the international financial market, the moral adventures of financial intermediaries will be transformed into excessive accumulation of securities financial assets and real estate, this is financial excess. When the interest rate in the country rises, the financing cost of the enterprise rises. It is very likely that a company will fall into a financial crisis because the loan is interrupted by the bank, or even go bankrupt. When the national currency depreciates, it will reduce the investment of international investors in this country, so that the economy will further deteriorate. Once a company encounters a financial crisis, it will not be able to repay the principal and interest, the bank will not be able to recover the cost and profits in a timely manner, and may face a bank run or bankruptcy crisis. when talking about the risk of financial events triggered by NPLs, Chinese real estate and Small and medium

[3] It was proposed by American economist Paul Krugman in 1979. Krugman believes that domestic credit expansion will bring about the loss of foreign exchange reserves under the condition that the country's currency demand is stable. Resulting in a crisis against the fixed exchange rate.

enterprises (SMEs) are the biggest victims. For example, in the face of the 2008 financial crisis, the aftermath of Chinese macroeconomic regulation and control injection of 4 trillion Ren Ming Bi (RMB) investment is the collapse of Chinese real estate bubble. After the emergence of *ghost town*[4], unfinished building and other phenomena (Ma, 2012).

[4] With the advancement of urbanization, more and more new urban areas with high standards and high standards have emerged. These new urban areas are too vacant and rarely inhabited. They are dark in the night and are called “ghost towns”.

3 Macroeconomic Determinants of Non-performing Loans

The main content of this chapter is to explain the impact of macroeconomic factors such as economic growth, inflation rate, interest rate, money supply, and unemployment rate on NPLR based on the existing economic theories.

3.1 The Impact of Macroeconomic Environment on Non-performing Loans Ratio

For a long time, the sustained growth of Chinese economy has mainly been maintained by continuously expanding production, and the government has placed too much emphasis on the growth rate of the gross national product, and has adjusted the social economy accordingly with GDP as the key. These regulations were mainly implemented from two aspects: fiscal policy and monetary policy. In order to maintain the high-speed operation of the economy, the government increased the amount of currency issuance. Bank loans increased significantly, with the continuous expansion of bank loans and the relaxation of credit standards and loan approvals, many companies with poor operating conditions and overcapacity can continue to operate with the support of bank loans. When the economy is obviously overheated, the government takes corresponding measures to cool down the economy, transforming the economic structure, slowing down the economic growth, reducing the money supply, and cautiously issuing bank credits. Strengthening government supervision has made it more difficult for some companies that are already having problems to operate enterprises have experienced difficulties in repaying loans. A large number of normal loans (pass and special-mention loan) have turned into NPLs, and the quality of credit assets of banks has deteriorated drastically.

In the past, Chinese economic growth mode was mainly based on the government-led extensive business model, the government's pre-emptive regulation of the market was very strong. As the main body of Chinese commercial banks industry, Chinese state-owned commercial banks often follow the government's policy granting the loans to enterprise industry, and a large part of these loans are invested in state-owned

enterprises. When Chinese economy gradually transforms and the planned economy changes to the *socialist market economic system*[5], most state-owned enterprises have undergone bankruptcy reorganization with the permission of the government in order to reform into a joint-stock enterprise to adapt to the socialist market economic system. During the reform of Chinese economic transformation, the original loans owed by the company to the bank no longer need to be repaid. State-owned commercial banks have undertaken most of the reform costs and thereby accumulated a large amount of non-performing assets.

The most important factor is the impact of asset price bubbles, which mainly refer to the prices of important assets such as real estate, stocks, bonds, gold, and foreign exchange. When the social and economic environment in a prosperous period, the economy continues to grow and the rise in inflation rate will not be as fast as expected, this will attract some funds to enter the capital market from other economies. The inflow of *hot money*[6] will push up asset prices, and the inflow of funds will continue to increase. Investors are gradually showing an irrationality, and as asset prices continue to rise, the asset price bubbles are being created. In the initial stage of the asset price bubble, asset prices showed a very obvious upward trend, which made investors to have good profit expectations, especially for some investors who have speculative psychology, this market atmosphere is very attractive to them. Inevitably, a large number of investors are attracted to invest in these "bubble assets". As an intermediary of financial communication, commercial banks will inevitably be involved in this

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[5] The socialist market economic system is the market economic system established by China's reform and opening up. When Deng Xiaoping made a speech in the southern tour in 1992, he proposed to establish a socialist market economic system. The 14th National Congress of the Communist Party of China formally proposed the goal of establishing a socialist market economic system.

[6] Hot money is currency that moves regularly, and quickly, between financial markets, so investors ensure they are getting the highest short-term interest rates available. Hot money continuously shifts from countries with low-interest rates to those with higher rates; these financial transfers affect the exchange rate if there is a high sum and also potentially impact a country's balance of payments.

irrational investment behavior, the bubble assets are in a period of soaring prices, projects that invest in such assets are profitable. Bubble assets (generally refers to real estate) also appear to be safe as collateral, banks will loosen credit approval restrictions on investing in these bubble asset projects and expand the amount of credit granted to these projects. When a bank issues a large amount of credit to a bubble asset project, most of the risk is transferred to the bank, and the quality of the bank's corresponding credit assets will deteriorate rapidly. When the asset price bubble bursts, the price of the bubble asset falls sharply, the lender cannot obtain enough income to repay the bank's principal and interest, and the bank's large assets will change from the normal level to the bad level, the situation that will eventually lead to bad loans will worsen.

3.2 Economic Growth

Combining the existing economic theories with Chinese actual economic situation, this thesis divides the economic development stage into four stages, namely "Rapid growth stage", "Slowdown in growth stage", "Mature stage" and "Recession stage". Moreover, this thesis will analyze how economic growth affects the NPLR of commercial banks from these four stages.

3.2.1 Rapid Growth Stage of Economic Growth

The neoclassical growth theory postulates that the growth patterns of different countries will converge, while developing countries have faster development speed. The economic level of developing countries should eventually catch up with the economic level of developed countries. In a process in which a country's economic growth converges toward a balanced growth path, the growth model will gradually evolve from initially immature, high-risk and non-standard to mature, low-risk and regulated, the risk here can be reflected to some extent by the bank's loan default rate. It is normal to have risks in the process of economic growth; these risks can be divided into systemic risks and non-systemic risks. The majority of definitions of macroprudential policy point out the limitation of risk and cost of systemic events

(Galati and Moessner, 2010). Systemic events are an essential element of systemic risk and are composed of two basic components, i.e. shock (idiosyncratic or systematic) and propagation mechanism (Bandt and Hartmann, 2010). The view on the systemic risk is not unified in the literature. Therefore, the different definitions of systemic risk are presented. In the narrow sense, systemic risk might be described as a transmission of contagion initially caused by an idiosyncratic shock when the risk of failure of a single participant of system can cause other participants to fail and through a chain reaction it might lead to a major financial problem (Bank for International Settlements, 1994). This understanding of systemic risk thus corresponds to the horizontal form of systemic risk (Bandt and Hartmann, 2000) which focuses exclusively on issues arising in the financial system. The interactions between the financial sector and the real economy are taken into account by the definition of vertical form of systemic risk (Bandt and Hartmann, 2000). For example, Committee on the Global Financial System (CGFS) defines systemic risk as a risk of disruption of financial services that is caused by deterioration in all or some parts of financial system, and which has the potential to have serious negative impacts on the real economy (CGFS, 2010). Systemic risk may also be characterized as a probability of default of the whole system (in contrast to the failure of individual components), which is accompanied by the interconnection of all or majority of parts in the system. Therefore, the systemic risk in the banking industry is related to the high correlations and clustering of bank failures in individual countries, groups of countries or even globally (Kaufmann and Scott, 2003). In this thesis, the systemic risk is perceived as the probability of failure of the whole system (the banking sector) which is related to the risk factors that may negatively affect the stability of the system. Thus, the systemic risk is not only perceived in the context of transmission of contagion caused by idiosyncratic shock, but it is also connected to systemic events triggered by a broad-acting (systematic) shocks that have simultaneous impacts on significant number of financial institutions and markets. In accordance to the view of Borio (2003), the systemic risk is perceived as an endogenous risk as it reflects the

interactions between the financial system and the real economy. The underdeveloped countries are in the initial stage of economic development, the entire economic system is imperfect and non-standard. Moreover, each micro-subject does not have sufficient risk awareness, experience and resilience, Therefore, the risk of the whole society rises with the acceleration of economic growth, which is reflected in the increase in the NPLR of commercial banks. (Romer, 1986).

3.2.2 Slowdown in Economic Growth Stage

During the slowdown of economic growth, the main performance of growth rate is from high-speed growth to medium-speed growth. At this stage, the growth momentum of the initial stage of growth shows a weak state, with the transformation of Chinese economy and the increase in openness to the outside world, objective economic conditions, economic system, and market environment have all changed. This change has made it impossible for heavy industry to support the rapid growth of the national economy. If the global economy is at a low speed growth or there is negative growth rate at this time, the effective demand for domestic consumption and international exports will become increasingly insufficient, and the national income will drop sharply. The slowdown in economic growth is both a stage of economic slowdown and a stage of contractions. Because the old economic development model cannot play a big role at this stage, the state and various economic entities are looking for new development paths, but at the same time, the new and old development models will exhibit various contradictions and problems. For example, *excess capacity*[7], large gap between rich and poor, structural unemployment, and financial risks are constantly emerging. These risks are obviously reflected in the NPLR of commercial banks (Romer, 1986).

[7] Capacity refers to the ability to produce products. Excess capacity is the ability to produce products. If saturated, the products produced will exceed the needs of society. Therefore, excess capacity is not a surplus of products - even if the products are not left, the production capacity may be excessive.

3.2.3 Mature Stage of Economic Growth

The abovementioned neoclassical growth theory emphasizes that when economic growth converges to maturity, the growth model will develop to be more mature, normative and low-risk. If a country's economic growth stage is at a mature stage, the country's economic system, legal system, and political structure are relatively standardized and mature. The systemic risks in the economy will be relatively small, and various economic entities have accumulated considerable investment and personal asset management experience is very robust, so these economic entities will be more capable to resist systemic risks. At this time, if the country relies on innovation to achieve rapid economic growth again, it will help improve the economic situation of each borrower, so that there are sufficient funds to repay the loans, and the NPLR will be at a lower level. However, economy in its mature stage could be affected by various unexpected shocks. For example, the global financial crisis, war, and political crisis will cause losses to financial market, which will inevitably affect the NPLR (Romer,1986).

3.2.4 Economic Recession Stage

An economic recession is when the economy declines significantly for at least six months. That means there's a drop in the following five economic indicators: real GDP, income, employment, manufacturing, and retail sales. People often say a recession is when the GDP growth rate is negative for two consecutive quarters or more, but a recession can quietly begin before the quarterly GDP reports are out. That's why the National Bureau of Economic Research measures the other four factors (The Balance, 2019).

In the recession stage, there are three main characteristics. First, the purchasing power of consumers is declining. Second, the demand for labor in the labor market is declining. Due to the decrease in demand, the factories are shut down, and enterprises will be streamlined to reduce labor costs or carry out reforms. The layoffs have led to an increase in the number of unemployed people. Third, the output has declined. On the

one hand, market demand is insufficient. On the other hand, insufficient market demand leads to a decline in market supply, and companies must reduce production and lead to a decline in economic vitality (Romer, 1986).

In the recession stage, unemployment reduces personal income levels, and the NPLR of personal loans will rise. The company's operating conditions getting worse will increase the NPLR of corporate loans. Moreover, the problem of NPLs in the recession is that all or majority of industries are simultaneously erupting, commercial banks cannot avoid this risk and can only try to minimize losses.

3.3 Inflation

The study of the relationship between inflation rate and NPLR in the field of economics is ambiguous, but most scholars believe that inflation will lead to an increase in NPLR. Mihail and Jordan (2018) published their views in the article: at first, higher inflation enhances the loan repayment capacity of borrowers by reducing the real value of outstanding debt. However, bank's managers anticipate higher inflation, which, in turn, implies that interest rates are being appropriately adjusted, weakening the loan repayment capacity of the borrowers. Next, the thesis analyzes the relationship between the two from multiple perspectives in detail.

3.3.1 Inflation Income Distribution Effect

The income distribution effect of inflation is related to the income form of social entities. Under normal circumstances, when the price in the market rises, it is unfavorable to the fixed income earners, because the actual purchasing power of these people declines, however, the price increase is beneficial to the variable income. The typical representative of this group is an enterprise, which can flexibly adjust its price according to the actual situation in the market. In the short term, the contract price of the enterprise and other partners (such as raw material suppliers) remains unchanged, but the sales price has increased. Under this circumstance, the profitability of the enterprise has risen, and the enterprise has more income to repay the bank loan, and the

NPLR will also be decline. Inflation will not only increase the actual income of the profit earners, but it will also reduce the real value of debt amount of the debt, because the debtor's loan contract is generally signed before the inflation, and the contract also stipulates the repayment amount. Inflation will reduce the burden on the debtor, therefore, the NPLR will decrease under inflation (Ren, 2014).

3.3.2 Inflation Output Effect

Existing economic theories usually classify inflation into demand-driven inflation, cost-driven inflation, and Hybrid inflation. If we assume that we do not consider the case of the inflation gap, demand-driven inflation is usually moderate, and it has an expanding effect on output and employment. Although inflation expectations have slightly weakened inflation economic growth effects, in general, this type of inflation will boost the national economy, development is conducive to reducing the NPLR. Cost-push inflation can be divided into two situations, the first is that wages promote inflation and the total demand remains unchanged. If the increase in wages causes the unit cost of the product to increase, it will lead to price increases. After the price rises, if workers ask for higher wages and increase the cost again, it will cause prices to rise again, this cycle is called the wage-price "spiral." Many economists identified inflation experienced by most European countries in the late 1960s and early 1970s as wage-driven inflation. For example, in the Federal Republic of Germany, the annual growth rate of working hours has jumped from 7.5% in 1968 to 17.5% in 1970. During the same period, the annual growth rate of working hours in the United States rose from 7% to 15.5%. In the second case, profits promote inflation, oligarchs and monopolies rely on the power of their monopoly market to offset the increase in cost or to increase profits. As an excuse to increase the price of goods, as a result, the overall price level rises. Most typically, between 1973 and 1974, the Organization of Petroleum Exporting Countries (OPEC) historically increased oil prices by a factor of four. By 1979, oil prices were again raised, triggering an oil crisis, both of these situations have a negative

impact on the economy, which leads to an increase in the NPLR. Hybrid inflation means that because when wages increase, people's demand will also increase, so cost-driven inflation will also trigger demand-driven inflation, in reality, it is difficult to distinguish whether demand is driven by demand or cost. Samuelson (1958) proposed mixed inflation, which refers to inflation caused by the combination of demand and cost, that is, inflation mixed with demand and cost factor, under hybrid inflation, the NPLR is not a one-way rise or fall, and the relationship between the two becomes ambiguous.

Therefore, whether inflation can reduce the NPLR should be discussed separately. The impact of different types of inflation on NPLR is the opposite.

3.3.3 Inflation Asset Structure Adjustment Effect

The asset structure adjustment effect of inflation is also called the wealth distribution effect, it is related to the existent form of assets. The value of various physical assets such as houses, land and automobiles will rise in the inflation environment; especially, the residential house price in inflation period. During such a period, the real value of the debt will decrease in the inflationary environment, that is, the debtor will pay less in real terms, so the debtor will pay less and the actual amount of money to pay off the debt. Inflation rate wealth distribution effect will prompt the nationals to choose to purchase real estate when the inflation rate is high, and will not hold the money in cash or store it in the bank for reserve. Therefore, commercial banks will be more cautious when lending new loans, which will reduce the NPLR.

3.4 Unemployment

When studying the impact of unemployment rate on NPLR, this thesis starts from two perspectives. The first is to analyze it from the perspective of enterprises. From the perspective of enterprises, corporate layoffs can be classified into three situations. The first case is poor management, due to the microscopic reasons of the company itself, the business operation costs are increased due to poor management of the enterprise, and the company has to reduce the operating cost of the enterprise by means of layoffs.

In the second case, due to the overall macroeconomic downturn, insufficient effective demand, the operating environment of the enterprise has deteriorated and the operating costs have become higher, companies need layoffs to reduce costs. The third situation is the company's strategic layoffs, that is, layoffs in order to adjust the industrial structure or change the direction of investment in the industry. If a large number of corporate layoffs occur in a country, it means that the layoffs are likely to fall into the second situation, that is, because the overall macroeconomic downturn, when economy is in the stage of insufficient effective demand (i.e. consumption, investment, government purchases, and net exports). The continuous decline in demand has made the company's initial investment unprofitable, and the company naturally cannot repay on time. The NPLR of corporate loan types has naturally increased.

From the perspective of consumers, unemployment means that consumers do not have a steady flow of cash in the future, that is, borrowers do not have enough disposable income to repay bank loans, such as mortgages or consumer loans. In the case of personal loans of *third-and fourth-tier cities*[8], the monthly payment is relatively small, and temporary unemployment has little effect on person´s repayment. However, for the borrowers in *first-tier cities*[9] and second-tier cities, where house prices are very high, their monthly payment is relatively high. Once they are unemployed, the loan is difficult to repay. Most people are unable to provide monthly payments on time, so the volume of problem loans created from personal loans will rise.

[8] Third-tier cities refer to medium-sized cities with strategic or relatively developed development. Most of them are regional central cities in the central and eastern regions, and some capital cities in the western regions. Four-tier cities refer to general prefecture-level cities.

[9] First-tier cities refer to metropolitan cities that play an important role in leading social and economic activities, and second-tier cities generally refer to provincial capital cities.

3.5 Monetary Policy

The impact of monetary policy on bank credit risk is a key factor to be considered in Chinese macro-prudential management framework. After the global financial crisis in 2008, domestic and foreign scholars focused on the relationship and impact of monetary policy and bank credit risk. Gianni's (2010) empirical study shows that low interest rates and a loose monetary policy environment tend to induce banks to seek higher returns and take greater risks, the latter often accompanied by higher financial leverage and lead to financial bubbles. Giovanni and Marquez (2010) Through a study of the quarterly data of the 1997-2008 US business lending survey, it was found that the central bank's real interest rate level has a significant negative correlation with the bank's credit risk.

In the 2008 financial crisis, China was much less affected than the United States and other Western countries, this is mainly because the openness of Chinese financial system is not high, and financial regulation was strict. However, after the global financial crisis, in order to stimulate economic development, China has cut interest rates several times. So far, the benchmark interest rate has been lowered by 1.5%, the statutory deposit reserve ratio, the one-year deposit rate, the loan interest rate and the statutory deposit reserve ratio of large financial institutions has fallen. From the perspective of the monetary policy implemented by the People's Bank of China (PBC), both interest rate cuts and Reserve ratio cuts indicate that economic growth has encountered a certain degree of obstacles, both instruments were intended to stimulate economic growth. But looking at the world's developed countries and emerging market countries, in most cases, the central bank has not lowered the reserve ratio and cut interest rates at the same time, but the PBC adjusted both reserve ratio and interest rate on October 24, 2015. At the same time, the implementation of the above policy reflects that the Chinese economy is indeed in a recession and needs to be stimulated, therefore, as the intensity of monetary policy continues to increase, the impact on the NPLR is

also increasing. This thesis mainly studies the impact of monetary policy on NPLR from the point of two adjustment variables: interest rate and money supply.

3.5.1 Interest rate

When studying the impact of interest rates on NPL ratios, it is not easy to draw conclusions about positive or negative correlations. It is usually a hedge or superposition of two effects. Firstly, it could be analyzed from the theoretical basis of neoclassical economics. In the non-flow preference trap area, interest rates are lowered, it can reduce the cost of financing, stimulate private investment, and promote economic growth, thus reducing the NPLR. However, according to the risk-taking channel theory, the interest rate reduction will increase the price of assets and the value of the loan collateral. Under this circumstance, banks will reduce the risk assessment and measurement of loan risks because of the decline in return on investment. This move will increase the bank's NPLR. On the other hand, enterprises generally over-borrow and over-invest in low-cost financing environment, many investment projects are ineffective because the cost of borrowing money is much lower than the transaction cost of investigating whether a project can make money. When the company does not use all the borrowings in effective projects, it is usually impossible to recover the cost, and it is impossible to achieve profitability. Eventually, the company will not have enough funds to repay the loan, resulting in an increase in the NPLR (Keynes, 1936 and Zhou, 2017).

3.5.2 Money Supply

Generally speaking, when a country implements an expansionary monetary policy, one of the important measures is that the central bank issues a large amount of funds to the market, the total amount of funds available for the market will increase, and the interest rate of the loan will fall, which will stimulate investment and consumption. The company's operating conditions have changed and its profitability has improved, and personal disposable income has also increased. With sufficient income to repay bank

loans, the NPL ratio will fall. When a country tries to tighten the monetary policy, the amount of currency in the market will decrease, the bank's loan interest rate will rise, the cost of corporate loans and other types of loans will increase. The profits of enterprises will fall and profitability will decline. As a result, it is impossible to repay on time, which eventually leads to an increase in the NPLR (DRC, 2003).

4 Analysis of Effects of Selected Macroeconomic Determinants on Non-performing Loans

The content of this chapter is divided into three parts. The first part is to introduce the chosen methodology, the second part is to describe the selected macro variables in detail, and the third part is an empirical analysis of the data, i.e. estimation of the model parameters.

4.1 Introduction to Autoregressive Distributed Lag Models methodology

Domestic and foreign scholars research on the impact of macroeconomic variables on NPLR, they use a large number of econometric methods, including VAR models, GARCH models, VEC models, and so on. This thesis adopts the theory and method of dynamic econometric model proposed by D. F. Hendry in the late 20th century, and adopts the autoregressive distributed lag model (ARDL) to study how the macroeconomic variables of the current period or the past period affect the NPLR.

The basic specification of ARDL model is as follows:

$$y_t = c_0 + \sum_{i=0}^{p} \emptyset_i y_{t-i} + \sum_{i=0}^{q} \beta_i \, x_{t-i} + u_t \tag{4.1}$$

where u_t is a random "disturbance" term. The model is autoregressive, in the sense that y_t is explained (in part) by lagged values of itself. It also has a "distributed lag" component, in the form of selected lags of the "x" explanatory variable. Sometimes, the current value of x_t itself is excluded from the distributed lag part of the model's structure.

Let's describe the model above as being one that is ARDL (p, q), for obvious reasons.

Assumptions for ARDL Model: (i) Absence of autocorrelation in residuals is the

very first requirement of ARDL. The model requires that the residuals should have no autocorrelation with each other. (ii) There should not occur any heteroscedasticity in the model´s residuals. In simple terms, a situation in which the error term (that is, the "noise" or random disturbance in the relationship between the independent variables and the dependent variable) is the same across all values of the independent variables. (iii) The residuals should follow normal distribution. (iv) Data should have an order of integration such as I (0), I (1) or both options. In addition to this, if any of the variable in the data has order of integration of I (2), i.e. it is stationary on 2nd differences, the ARDL model cannot run correctly.

4.2 Description of Empirical Data and Time Series

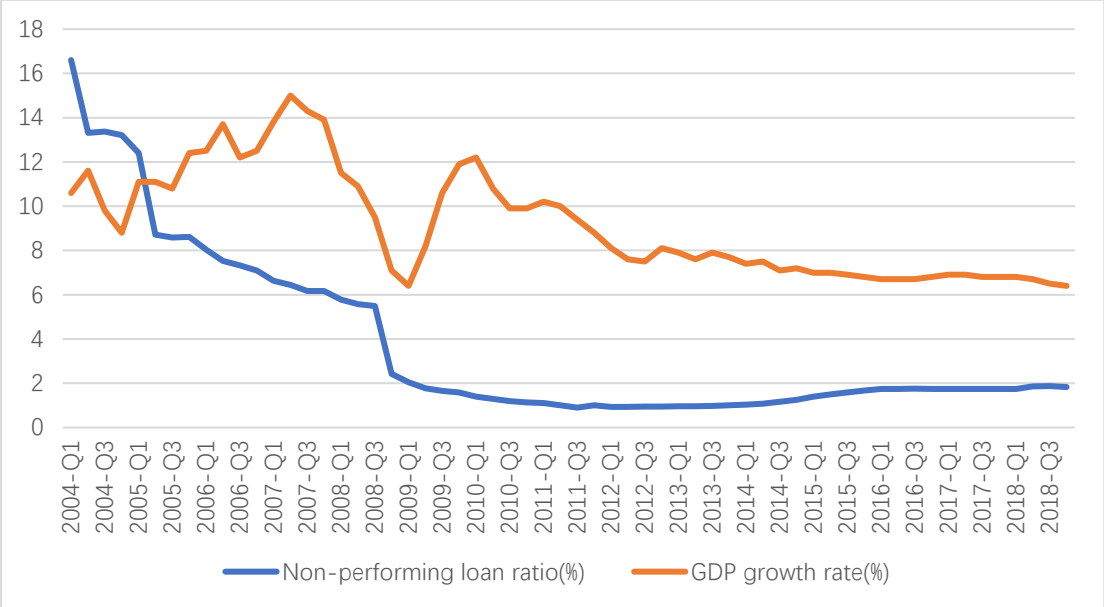
In this section, this thesis provides a simple description of the data, i.e. NPLR and selected macroeconomic variables, and explains the changes in the data in light of Chinese specific economic conditions.

4.2.1 Chinese Economic Growth and Non-performing Loans Ratio

During the period of 2004-2010, the *demographic dividend*[10], the institutional reform dividend and the globalization dividend brought great benefits to Chinese economic development. For this reason, Chinese GDP continued to grow at a rate of more than 10% (China Statistics Network, 2018). However, since 2011, Chinese GDP growth rate has gradually declined, China entered the stage of *three-phase superposition*, that is, the period of economic growth, the period of economic restructuring, and the period of digestive policies (China News Network, 2014).

[10] Demographic dividend refers to the fact that the working-age population of a country accounts for a large proportion of the total population, and the dependency ratio is relatively low, which creates favorable population conditions for economic development.

Figure 4.1 Chinese Non-performing Loan Ratio and GDP Growth Rate in 2004Q1-2018Q4



Source: China Statistics Network (2018), self-elaboration

As shown in Fig. 4.1, the relationship between Chinese economic growth rate and NPLR before 2010 is relatively complicated, and there is no obvious correlation. However, since 2010, there is opposite trend between the two variables, the bank's NPLR mildly increased with the decline in GDP growth rate. Here we need to explain the reasons for the sudden drop in Chinese GDP growth rate and Chinese commercial banks NPLR. On the one hand, the global financial crisis that broke out in 2007 affected Chinese economic development, Chinese GDP growth rate has rapidly declined from 15% in the second quarter of 2007 to 6.4% in the first quarter of 2009. On the other hand, in 2008, Chinese four major asset management companies helped the Agricultural Bank to dispose of NPLs of 815.7 billion yuan, which reduced the NPLR of the Agricultural Bank by 19.3%. It also reduced the NPLR of the entire commercial bank's sector from 6.17% at the end of 2007 to 2.42% at the end of 2008. Therefore, we must pay attention to this special situation in 2008 when analyzing the relationship between Chinese economic growth and NPLR. Although the subprime mortgage crisis in the United States seriously affected Chinese import and export in 2009, due to the

government's *Four Trillion Plan*[11], investment drove Chinese GDP to rise rapidly. In 2010 and 2011, as the GDP growth rate slowed down, the rate of decline in the NPLR of commercial banks also slowed down. Since 2012, GDP growth has begun to stabilize, and the growth rate has begun to remain around 7%. As of the end of 2014, the GDP growth rate has reached 7.4%, and the NPLR of commercial banks has also ended a downward trend within a few years, and has mildly increased since 2012.

From the perspective of GDP growth rate, from 2009 to 2011, during the three years of economic expansion, banks have increased new credit supply, this move has accelerated economic growth, the acceleration of economic growth has led to strong market demand and abundant liquidity. The company's financing ability has been enhanced, sufficient funds and a good market environment have made the company's production and operation in good condition. The company's profitability was improved, their solvency was enhanced, and individuals are increased their disposable income, and their creditworthiness was more assured. However, due to economic prosperity, banks are too optimistic regarding the future situation, credit approval for enterprises and individuals is more relaxed (i.e. there are lower credit standards) and banks expand amount of granted credit. Banks accumulated a lot of low-quality credit assets, which lead to uncertainty of banks, because low-quality loans greatly increase the bank's bad loans.

Since 2012, the economy has entered a period of austerity, economic growth has

[11] In September 2007, after the outbreak of the international financial crisis, China's economic growth rate fell rapidly, exports experienced negative growth, and a large number of migrant workers returned home, and the economy faced a risk of a hard landing. In response to this crisis, in November 2008, the Chinese government introduced ten measures to further expand domestic demand and promote steady economic growth. Initially, the implementation of these ten measures required an investment of 4 trillion yuan by the end of 2010. Over time, the Chinese government has continuously improved and enriched the policies and measures to cope with the international financial crisis, and gradually formed a package plan to deal with it. Since then, some media and economic circles have still simply interpreted it as the Four Trillion Plan.

slowed down, market demand had been weak, most companies have poor operating conditions, corporate profitability has weakened, banks have more rigorous estimates of the future, and credit provision is strictly controlled. Liquidity in the market is tight, corporate financing capacity is declining. Individuals was also decline in the growth rate of disposable income due to the economic downturn, and they could reduce disposable income, and personal solvency decline. Commercial banks have accumulated credit assets with quality deterioration, their debtor's solvency has declined, and commercial bank's NPLR has risen.

4.2.2 Chinese Inflation and Non-performing Loans Ratio

From the end of 2006 to the beginning of 2008, the continued depreciation of the US dollar led to an increase in international raw material prices. The sharp depreciation of the yuan directly led to a surge in dollar-denominated prices of gold, oil and international raw materials and commodities. On July 23, 2005, China carried out the reform of the RMB exchange rate mechanism. The increase in the fluctuation range of the RMB exchange rate directly led to the rapid appreciation of the RMB, which made the expectation of RMB appreciation continue to increase. Under this trend, a large amount of international hot money has flooded into China. According to Chinese current foreign exchange rate system, after the inflow of hot money, the central bank issued a corresponding amount of local currency for redemption, which undoubtedly increases the money supply. The world's crude oil prices fluctuated drastically, and international oil prices continued to run at high levels. In December 2007, the world oil price was less than $90 a barrel, but in June 2008 it soared to a record high of $130 a barrel. This directly increased the pressure on domestic inflation in China. As a result, the inflation rate rose rapidly, what led to the depreciation of the RMB.

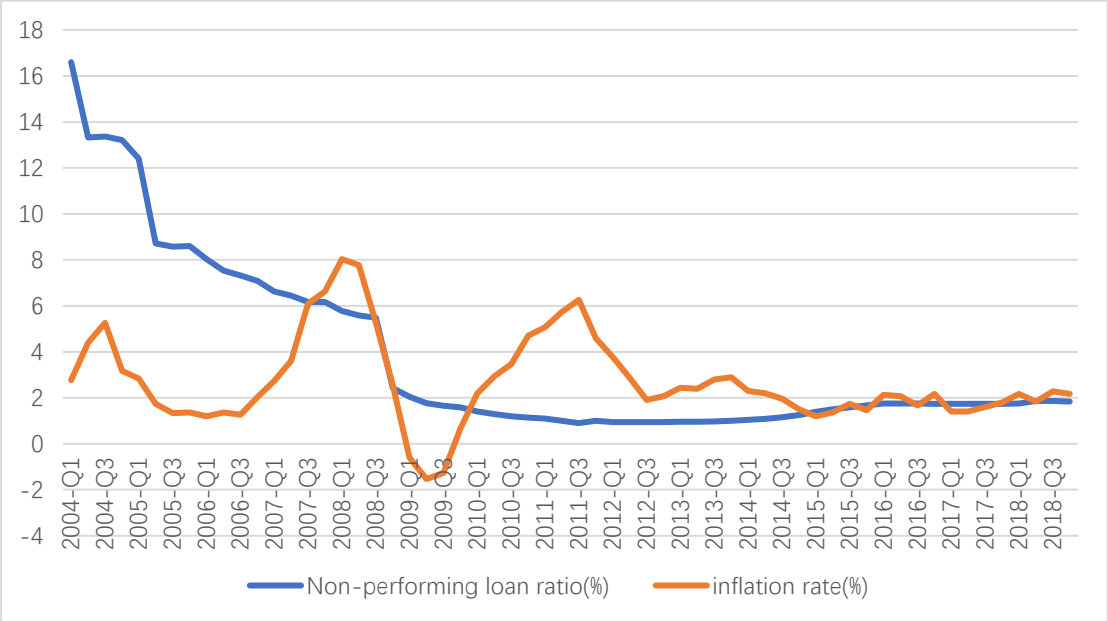
Since the second quarter of 2008, the inflation rate has dropped rapidly, and in the first quarter of 2009, China experienced deflation. The reason for the change is that Chinese overcapacity problem has erupted through the financial crisis after years of

accumulation. When signs of overcapacity began to surface in 2004 the Government tried to clamp down on new investment projects, the steel industry was a case in point. In 2004, Chinese steel production was about 400 million tons. Concerned about overcapacity, the government clamped down on construction of new steel mills. But strong demand for steel, attributable to real estate development and strong export demand, meant new steel mills continued to appear. Chinese steel production rose to more than 600 million tons in 2007.

Growth was sustained temporarily, but at the cost of economic equilibrium. Investment fever and strong external demand from mid-2007 meant Chinese inflation rate worsened rapidly. The strong external demand delayed the surfacing of overcapacity for many years.

But export demand is highly unstable. In the second half of 2008, export demand collapsed due to the global financial crisis. Long-postponed overcapacity surfaced suddenly. The sudden shift from inflation to deflation, in September to October 2008 was truly stunning (Yu, 2010).

Figure 4.2 Chinese Inflation Rate and Non-performing Loan Ratio in 2004Q1-2018Q4



Source: China Statistics Network (2018), self-elaboration

Since the second quarter of 2009, the inflation rate began to rise. In the fourth quarter of 2010, the inflation rate was 4.7%, because after the financial crisis, China has implemented an active monetary policy, and has continuously expanded the circulation of RMB to increase the money supply, resulting in excessive currency in circulation and rising prices, and in November 2008, China implemented a four trillion plan. The investment scale of 4 trillion yuan will greatly promote the economic development of China, but rely solely on investment-driven GDP growth, although the short-term growth of the economy has been achieved, it has also triggered inflation to a certain extent, leading to an increase in inflation. In order to prevent the inflation rate from rising, the government adopted tighter monetary policy such as raising interest rates and deposit reserve rate to regulate and control inflation rate. That in the fourth quarter of 2010, the central bank raised interest rates twice in a row. As the inflation continued to rise, it reached 6.27% in the third quarter of 2011, and the loan interest rate also rose to the 6.56%. The large change in inflation rate should have affected the NPLR. However, due to the intervention of the four major asset management companies and the timely implementation of monetary policy, the NPLR remained basically stable after 2008.

4.2.3 Chinese Unemployment Rate and Non-performing Loans Ratio

Combined with Chinese national conditions to analyze, and along with Chinese *Three Removals, One Reduction and One Supplement*[12] economic reform, Chinese unemployment tide has also slowly hit. According to statistics, in 2016, the number of personal bankruptcy cases accepted by the Chinese court system reached 5,665, a year-

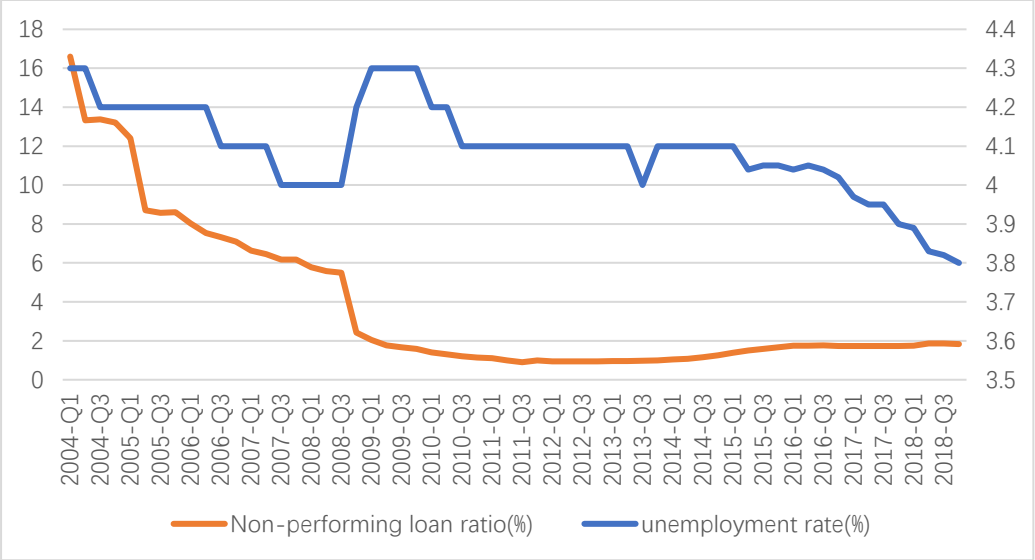
[12] That is to remove low-margin, high-pollution excess capacity, remove inventory to provide space for new capacity, eliminate leverage to reduce long-term and systemic risks, reduce costs to improve production efficiency, and complement short-board to improve overall resource allocation efficiency. It was proposed by General Secretary Xi Jinping based on structural reforms on the supply side of economy. The supply-side reform mainly involves three areas: overcapacity, the real estate market is overdeveloped, and high debt.

on-year increase of 54%. At the end of 2016, nearly 3,600 cases of corporate bankruptcy were concluded, and 85% of the cases led to the bankruptcy and liquidation of the defendant company. Among them, manufacturing is the industry most affected by corporate bankruptcy and employee unemployment. In the above bankruptcy liquidation cases, small and medium-sized manufacturing enterprises accounted for a large proportion, but only bankruptcy liquidation manufacturing enterprises from Zhejiang Province and Jiangsu Province accounted for more than 1,600 cases (Yu, 2018).

The official unemployment rate in China is based on the number of registered unemployed, therefore, the unemployment rate data is less volatile than other countries. Since the fluctuation of unemployment rate is much smaller than the fluctuation of NPLR, this thesis uses two axes to better show the change of variables.

The vertical axis on the left is the NPLR, and the right is the unemployment rate.

Figure 4.3 Chinese Unemployment Rate and Non-performing Loan Ratio in 2004Q1-2018Q4



Source: China Statistics Network (2018), self-elaboration

From Fig 4.3 we can see that the two groups of variables have basically the same trend from the first quarter of 2004 to the third quarter of 2008., the special time period

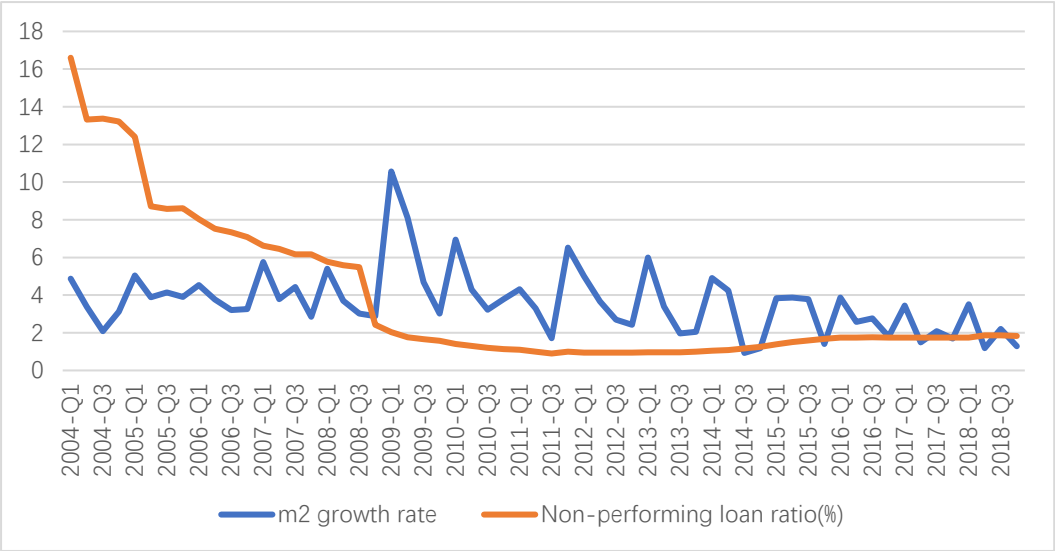
is from the third quarter of 2008 to the fourth quarter of 2009. The reason for the different trends was explained earlier in this thesis (see section 4.2.1), this is because Chinese asset management companies handled most of the bank's NPLs during this year.

In fact, in the new round of unemployment (during the economic reform period of 2011-2016), Chinese unemployment problem has obvious characteristics, that is, structural unemployment has gradually become the most prominent type of unemployment. The unemployment rate of industries with severe overcapacity has surged (e.g. steel production capacity has far exceeded demand, leading to large-scale layoffs of steel manufacturing workers). In the process of de-capacity in 2016, the central government spent more than 30 billion yuan to placement 726,000 workers in overcapacity industries. Therefore, we did not see from Fig 4.3 that there is an upward trend in Chinese unemployment rate in 2016, but these laid-off workers are unable to grasp the skills of other industries in the short term to transfer among jobs.

4.2.4 Chinese M2 Growth Rate and Non-performing Loans Ratio

As can be seen in Fig 4.4, the trend of M2 growth rate is fluctuating. In 2009, Chinese money supply rose significantly, and the growth rate reached a peak of 10.6%. Then with the economic recovery, the monetary policy has turned from loose to stable, that the M2 growth rate is slowing down.

Figure 4.4 Chinese M2 Growth Rate and Non-performing Loan Ratio in 2004Q1-2018Q4



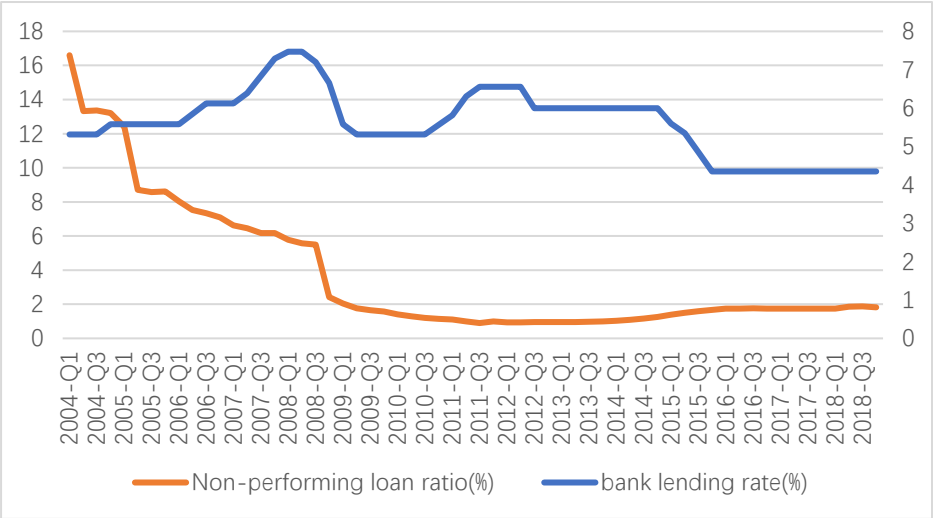
Source: China Statistics Network (2018), self-elaboration

As shown in Fig 4.4, the relationship between the NPLR and the M2 growth rate is basically not apparent, so we mainly description why the M2 growth rate is fluctuate so much between 2008 and 2009. This thesis mainly summarizes three reasons. First, a large amount of foreign exchange reserves. After the global financial crisis broke out in 2008, in order to adapt to the international market environment, Chinese total foreign exchange reserves have always ranked first in the world. The total size of Chinese foreign exchange reserves was only 21.7 billion U.S. dollars in 1992, but it reached 3.99 trillion U.S. dollars in June 2014. Second, a loose monetary policy. The 2008 economic crisis has caused heavy losses to the world economy, China was also affected by the financial crisis in 2008, the central bank lowered interest rates several times. By the end of the year, Chinese demand deposit rate had dropped from 0.72% to 0.36%. In the first quarter of 2009, the M2 growth rate increased significantly compared with the previous months, with a growth rate of 10.6%. The implementation of a proactive fiscal policy and a moderately loose monetary policy in 2009 is still an important means for China to regulate Chinese economic operations, resulting in a continuous increase in M2 growth rate.

4.2.5 Chinese Interest Rate and Non-performing Loans Ratio

As in the case of Fig 4.3, we use two axes to show the changes in the two variables. As can be seen from Fig 4.5, in addition to the proportional relationship in 2008, Chinese loan interest rate and NPLR trend are basically inversely related.

Figure 4.5 Chinese Interest Rate and Non-performing Loan Ratio in 2004Q1-2018Q4



Source: China Statistics Network (2018), self-elaboration

It can be clearly seen from the Fig 4.5 that the loan interest rate fluctuated greatly from first quarter of 2007 to first quarter of 2009. This is because the liquidity is too high and the market is overheated during this period. The central bank needs to be controlled by raising interest rates. After the second quarter of 2008, due to the deepening of the financial crisis, the economies of various countries have experienced major problems, and Chinese economic growth has also slowed down, therefore, it is necessary to stimulate positive interest rate reduction and positive fiscal policies. The 4 trillion investment plan is also implemented accordingly. After October 2010, the economy was basically stable, and domestic large-scale investment and excessively loose foreign monetary policies caused excessive market capitalization, and inflationary pressures were high, China entered an interest rate hike cycle. In the fourth quarters of 2015, Chinese lending rates fell by a large margin, because Chinese inflation rate has been at its lowest level since 2010. China began to implement a loose monetary

policy, cutting interest rates six times a year, stimulating consumption, facilitating corporate loans, and increasing social liquidity.

4.3 Model Estimation and Verification

In this chapter, we use empirical data from the first quarter of 2004 to the fourth quarter of 2018 for empirical analysis. The variables are: non-performing loan ratio (NPLR), inflation (INF), M2 growth rate (M2G), GDP growth rate (GDPG), unemployment rate (UNE), bank lending rate (BLR), which are represented by the abbreviations of the various variables in the following content, the data comes from China Statistics Network. The main steps can be divided into: the first step is to perform statistical analysis on the original data. In the second step, the unit root test of the basic data of the original data determines the stationarity of the time series. The third step is to establish a model and perform a diagnostic test. If the model passes the diagnostic test, the long-term cointegration relationship test can be performed. In the fourth step, an error correction model is established to explore whether short-term fluctuations will develop in the direction of long-term cointegration based on long-term cointegration. Finally, proceed to robustness checks, consider more possibilities, and try to find out if the original model has optimization possibilities.

4.3.1 Descriptive Statistics of the Data

Before going to the time series econometric analysis, a detailed statistical analysis is carried out. Our complete data set consists of fourteen years of quarterly observations from 2004Q1 to 2018Q4. The descriptive statistics are shown in Tab 4.1 and exhibits that the average of NPLR is 3.753% with standard deviation of 3.924346, the average for UNE is 4.093333% with standard deviation of 0.117843, the average for M2G is 3.611167% with standard deviation of 1.729763, the average for INF is 2.686541% with standard deviation of 1.906014, the average for GDPG is 9.19% with standard deviation of 2.443996, the average for BLR is 5.610833% with standard deviation of 0.864510.

Table 4.1 Descriptive Statistics of Selected Variables

	NPLR	UNE	M2G	INF	GDPG	BLR
Mean	3.753000	4.093333	3.611167	2.686541	9.190000	5.610833
Median	1.740000	4.100000	3.480000	2.186600	8.150000	5.580000
Maximum	16.60000	4.300000	10.56000	8.033334	15.00000	7.470000
Minimum	0.900000	3.800000	0.930000	-1.533333	6.400000	4.350000
Std. Dev.	3.924346	0.117843	1.729763	1.906014	2.443996	0.864510
Skewness	1.546568	-0.281723	1.339492	0.777197	0.649533	0.081862
Kurtosis	4.500829	3.116122	6.313801	3.932832	2.217703	2.446221
Jarque-Bera	29.54993	0.827391	45.39558	8.215782	5.748905	0.833693
Probability	0.000000	0.661202	0.000000	0.016442	0.056447	0.659122

Source: China Statistics Network (2018), self-elaboration in EViews10

All the variables are right skewed except UNE, which is negatively skewed. *Kurtosis*[13] statistic of the variables shows that NPLR, UNE, M2G and INF are leptokurtic (long-tailed or higher peak) and all other variables are platykurtic (short tailed or lower peak) A *Jarque–Bera*[14] test shows that the residuals of INF and M2G are not normally distributed while all other variables are normally distributed.

4.3.2 Unit Root Testing

In real life, many time series economic indicators are not stable, and the unit root process is the most common unsteady process. If the variables are subject to the unit root process, then using these variables to construct an econometric model is prone to regression, resulting in inaccurate regression results. Therefore, before constructing a model with macroeconomic variables, it is first necessary to test whether the variable has a unit root. Common methods are Augmented Dickey–Fuller test (ADF) test,

[13] In probability theory and statistics, kurtosis is a measure of the "tailedness" of the probability distribution of a real-valued random variable. The kurtosis of any univariate normal distribution is 3. It is common to compare the kurtosis of a distribution to this value. Distributions with kurtosis less than 3 are said to be platykurtic, although this does not imply the distribution is "flat-topped" as sometimes reported. Rather, it means the distribution produces fewer and less extreme outliers than does the normal distribution. An example of a platykurtic distribution is the uniform distribution, which does not produce outliers. Distributions with kurtosis greater than 3 are said to be leptokurtic.

[14] Jarque–Bera test is a goodness-of-fit test of whether sample data have the skewness and kurtosis matching a normal distribution. The test is named after Carlos Jarque and Anil K. Bera. The test statistic is always nonnegative. The null hypothesis is to obey the normal distribution.

Phillips–Perron test (PP) test and other methods, ADF and PP tests are based on the following assumptions:

H_0: There is a unit root, and the sequence is a non-stationary time series

H_1: There is not a unit root, the sequence is a stationary time series

Since there are many economic variables selected in this thesis, and they are all time series variables, there may be unit roots in each variable. Therefore, before performing the ARDL model, it is necessary to perform unit root test on each variable.

We use EViews to perform ADF tests on individual data, the results are as follows:

Table 4.2 ADF Test Results for Selected Economic Variables

variable	t-statistic	critical values(1%)	critical values(5%)	critical values(10%)	Stationarity
NPLR	-5.91064	-2.604746	-1.946447	-1.613238	Stationary(1%)
UNE	-1.40542	-2.604746	-1.946447	-1.613238	Non-stationary
D_UNE	-6.82187	-2.605442	-1.946549	-1.613181	Stationary(1%)
M2G	-0.70504	-2.606911	-1.946764	-1.613062	Non-stationary
D_M2G	-11.9363	-2.606911	-1.946764	-1.613062	Stationary(1%)
INF	-5.20774	-3.550396	-2.913549	-2.594521	Stationary(1%)
GDPG	-1.94077	-3.548208	-2.912631	-2.594027	Non-stationary
D_GDPG	-5.36994	-2.606163	-1.946654	-1.613122	Stationary(1%)
BLR	-2.1246	-3.548208	-2.912631	-2.594027	Non-stationary
D_BLR	-3.77157	-2.605442	-1.946549	-1.613181	Stationary(1%)

Source: China Statistics Network (2018), self-elaboration in EViews10 (that "D" represents the 1st difference operator).

It can be seen from the results of the ADF test that the original sequence of NPLR and inflation rate is a stationary sequence, that is, a zero-order single-order sequence I(0). Other sequences, BLR, UNE, M2G and GDPG, the original sequences of these variables are non-stationary sequences, but these variables become stationary sequences after first-order difference, so they are first-order single-order sequences I(1).

There are many ways to test the unit root. Although the ADF test is the most commonly used method for researchers to study stationary sequences, the ADF method will reduce the efficacy of the test in small samples. In order to improve the credibility

of the time series unit root test results, a variety of unit root test methods should be used to test and compare the results. If the test results reject the unit root process, it can be concluded that the sequence is a stationary sequence, so we use Phillips-Perron (PP) test to test the original data again.

Similarly, the results are as follows, see Tab 4.3:

Table 4.3 PP Test Results for Selected Economic Variables

variable	t-statistic	critical values(1%)	critical values(5%)	critical values(10%)	Stationarity
NPLR	-7.16695	-2.604746	-1.946447	-1.613238	Stationary(1%)
UNE	-1.3109	-2.604746	-1.946447	-1.613238	Non-stationary
D_UNE	-6.84617	-2.605442	-1.946549	-1.613181	Stationary(1%)
M2G	-6.42086	-4.121303	-3.487845	-3.172314	Stationary(1%)
D_M2G	-19.2459	-2.605442	-1.946549	-1.613181	Stationary(1%)
INF	-2.94785	-3.546099	-2.91173	-2.593551	Stationary(5%)
GDPG	-0.88366	-2.604746	-1.946447	-1.613238	Non-stationary
D_GDPG	-5.70545	-2.605442	-1.946549	-1.613181	Stationary(1%)
BLR	-0.53228	-2.604746	-1.946447	-1.613238	Non-stationary
D_BLR	-3.77157	-2.605442	-1.946549	-1.613181	Stationary(1%)

Source: China Statistics Network (2018), self-elaboration in EViews10 (that "D" represents the 1st difference operator).

Comparing the results of the two methods, we can find that the original sequence of NPLR is stationarity at 1% level of significant and the original sequence of INF is stationarity at 5% level of significant. variables UNE, GDPG and BLR have unit root at level, but after taking first difference UNE, GDPG and BLR become stationarity at 1% level of significant. We found that the two methods yielded different results for the test of the variable M2G, but after taking first difference the test results of the two methods are the same, M2G become stationarity at 1% level of significant. From the results of the unit root test, this set of data satisfies the prerequisites for establishing an ARDL model.

4.3.3 Basic Model Estimation and Residuals Testing

After a number of tests, we decided to set the maximum lag order of the dependent and independent variables to 4 (considering also the size of the dataset). According to

Giles's (2013) thesis "Information Criteria Unveiled" as a reference, we use Akaike's Information Criterion (AIC) for selecting the lag structure in the ARDL model. There's a risk of "over-fitting" the model, but definitely we do not want to under-fit it. Here's what we get:

Table 4.4 Estimation Results of ARDL Model

Fixed regressors: C
Number of models evalulated: 12500
Selected Model: ARDL(2, 1, 3, 4, 4, 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
NPLR(-1)	0.576688	0.125824	4.583296	0.0001
NPLR(-2)	0.245024	0.114908	2.132350	0.0405
UNE	-2.403099	1.519186	-1.581834	0.1232
UNE(-1)	1.885004	1.572201	1.198959	0.2391
M2G	-0.099773	0.051160	-1.950209	0.0597
M2G(-1)	-0.074919	0.044251	-1.693043	0.0999
M2G(-2)	-0.068681	0.044687	-1.536908	0.1338
M2G(-3)	-0.086079	0.044925	-1.916061	0.0641
INF	0.045955	0.103585	0.443647	0.6602
INF(-1)	0.016023	0.121518	0.131858	0.8959
INF(-2)	0.129265	0.119169	1.084719	0.2859
INF(-3)	-0.423267	0.115197	-3.674276	0.0008
INF(-4)	0.336773	0.097169	3.465845	0.0015
GDPG	0.365938	0.101185	3.616537	0.0010
GDPG(-1)	-0.452619	0.096901	-4.670949	0.0000
GDPG(-2)	0.144733	0.111935	1.293017	0.2050
GDPG(-3)	0.361636	0.107164	3.374591	0.0019
GDPG(-4)	-0.282460	0.081182	-3.479337	0.0014
BLR	0.104168	0.385965	0.269890	0.7889
BLR(-1)	0.261165	0.536547	0.486752	0.6297
BLR(-2)	-1.155332	0.489880	-2.358399	0.0244
BLR(-3)	0.884342	0.323774	2.731358	0.0100
C	1.568481	3.902626	0.401904	0.6903

R-squared	0.991612	Mean dependent var	3.012143
Adjusted R-squared	0.986019	S.D. dependent var	2.826491
S.E. of regression	0.334203	Akaike info criterion	0.938447
Sum squared resid	3.685821	Schwarz criterion	1.770288
Log likelihood	-3.276523	Hannan-Quinn criter.	1.260950
F-statistic	177.3195	Durbin-Watson stat	2.105669
Prob(F-statistic)	0.000000		

Source: China Statistics Network (2018), self-elaboration in EViews10

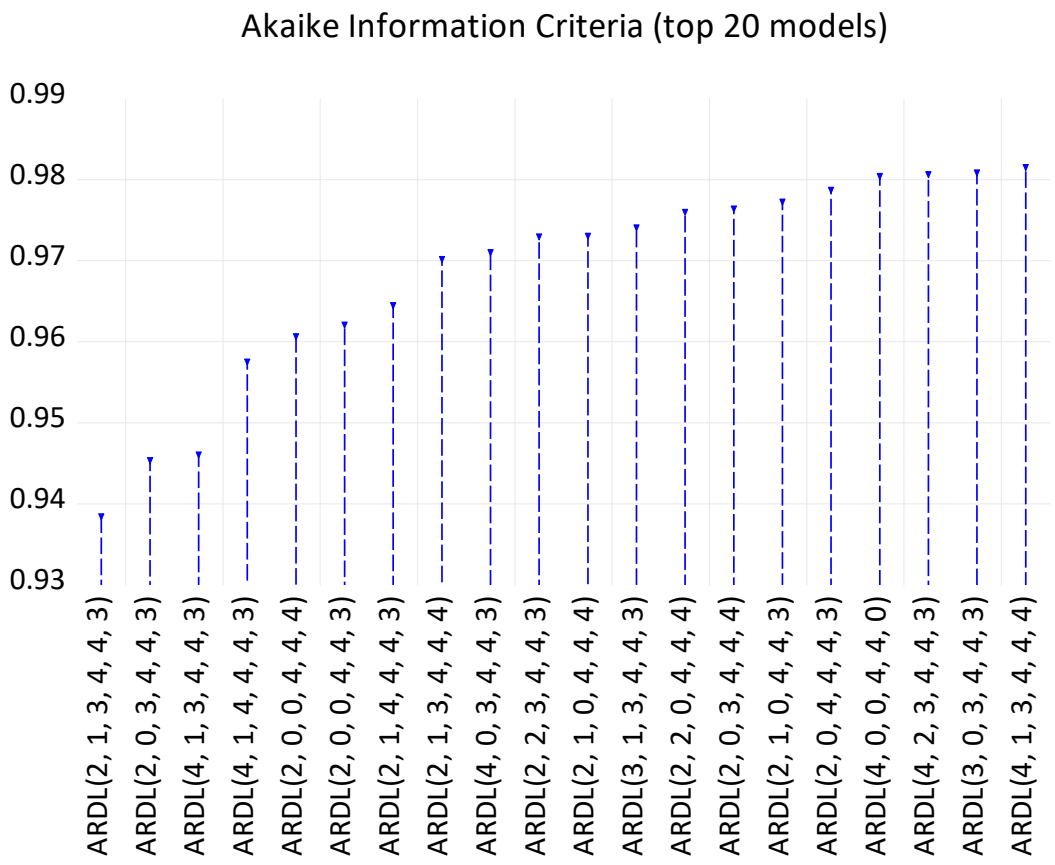
From the estimation results of the ARDL model, we can see that the adjusted R-squared is equal to 0.986. R-squared is statistical measure of how close the data are to the fitted regression line, the adjusted R-squared is a modified version of R-squared that has been adjusted for the number of predictors in the model. The adjusted R-squared increases only if the new term improves the model more than would be expected by

chance. It decreases when a predictor improves the model by less than expected by chance. The adjusted R-squared can be negative, but it's usually not. It is always lower than the R-squared. Our adjusted R-squared data is very high, indicating that the model has a high degree of fit.

F-test in regression compares the fits of different linear models. Unlike *t*-tests that can assess only one regression coefficient at a time, the *F*-test can assess multiple coefficients simultaneously. Our model's Prob(F-statistic) is equal to 0, this shows that the model is statistically significant as a whole.

Although an ARDL (2,1,3,4,4,3) was finally selected, from Fig 4.6 we can also see how well some other specifications performed in terms of Akaike Information Criteria.

Figure 4.6 Akaike Information Criteria (top 20 models)



Source: China Statistics Network (2018), self-elaboration in EViews10

The smaller the AIC value, the better the model specification, as we can see from

Fig 4.6. The selected ARDL (2,1,3,4,4,3) model was better than an ARDL (2,0,3,4,4,3) model, which was in turn better than an ARDL (4,1,3,4,4,3). It is notable that top 20 models most of them employ two lags of the dependent variable.

Next, we need to perform some tests on the model to ensure that the model has no autocorrelation, heteroscedasticity and the model´s residuals conforms to a normal distribution.

First, we carry out autocorrelation test, it's important that the errors of this model are serially independent, if not, the parameter estimates will not be consistent (because of the lagged values of the dependent variable that appear as regressors in the model), so we use Q-statistics and autocorrelation and partial correlation to determine the autocorrelation of the residuals.

Table 4.5 Autocorrelation Test

Q-statistic probabilities adjusted for 2 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.054	-0.054	0.1693	0.681
		2	-0.084	-0.087	0.5930	0.743
		3	0.004	-0.005	0.5942	0.898
		4	-0.096	-0.105	1.1743	0.882
		5	-0.128	-0.143	2.2215	0.818
		6	0.009	-0.029	2.2264	0.898
		7	0.109	0.085	3.0182	0.883
		8	-0.078	-0.083	3.4320	0.904
		9	0.003	-0.020	3.4326	0.945
		10	0.105	0.078	4.2153	0.937
		11	-0.123	-0.101	5.3038	0.916
		12	-0.009	-0.001	5.3104	0.947
		13	-0.170	-0.220	7.4856	0.875
		14	0.040	0.021	7.6076	0.909
		15	0.082	0.071	8.1380	0.918
		16	-0.043	-0.079	8.2853	0.940
		17	0.022	-0.036	8.3260	0.959
		18	-0.083	-0.115	8.9181	0.962
		19	0.158	0.177	11.105	0.920
		20	-0.170	-0.171	13.698	0.845
		21	-0.074	-0.121	14.206	0.861
		22	0.042	-0.039	14.371	0.888
		23	0.021	0.084	14.413	0.914
		24	0.012	-0.039	14.428	0.936

Source: China Statistics Network (2018), self-elaboration in EViews10

AC is the autocorrelation coefficient of the sequence, that is, the correlation

coefficient between the t-phase sequence and the t-k phase sequence; PAC is the partial correlation coefficient of the sequence, that is, the partial regression coefficient of the t-phase sequence for the t-1, t-2, ... t-k phase sequence. The Q-statistic obeys the chi-square distribution, and the value of Q is positively correlated with the magnitude of the autocorrelation coefficient, so when the autocorrelation coefficient is larger, the sample Q-statistic is larger, the smaller the P-value, the more the null hypothesis that the autocorrelation coefficients are all zero, that is, the sequence has an autocorrelation relationship, otherwise there is no sequence correlation (Gujarati, 2011). As can be seen from Tab 4.5, they strongly suggest that there is no evidence of autocorrelation in the model's residuals.

Heteroskedasticity refers to a condition in which the variance of the residual term, or error term, in a regression model varies widely. If this is true, it may vary in a systematic way, and there may be some factor that can explain this. If so, then the model may be poorly defined and should be modified so that this systematic variance is explained by one or more additional predictor variables. The opposite of heteroskedasticity is homoskedasticity, i.e. homoskedasticity refers to a condition in which the variance of the residual term is constant or nearly so. Homoskedasticity is one assumption of linear regression modeling. Homoskedasticity suggests that the regression model may be well-defined, meaning that it provides a good explanation of the performance of the dependent variable, so we need to check if the model is heteroscedastic (Gujarati, 2011), and Tab 4.6 is the output of EViews:

Table 4.6 Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

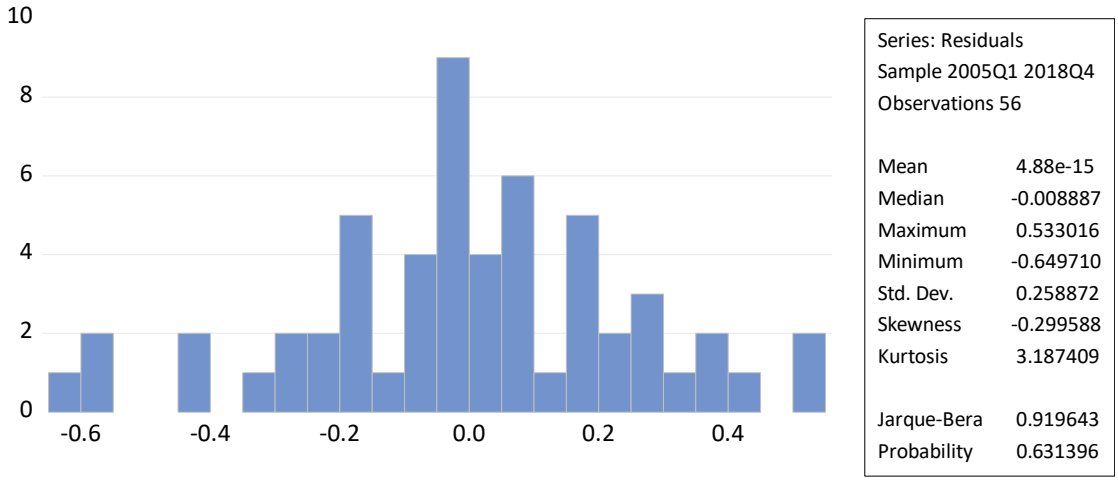
F-statistic	1.245620	Prob. F(22,33)	0.2780
Obs*R-squared	25.40581	Prob. Chi-Square(22)	0.2781
Scaled explained SS	9.649057	Prob. Chi-Square(22)	0.9892

Source: China Statistics Network (2018), self-elaboration in EViews10

As can be seen from Tab 4.6, the p-values of F-statistics, Observation R-squared and scaled-explained SS are all greater than the confidence levels of 95%, so we do not reject the null hypothesis, the model´s residuals are homoscedastic.

Next, we perform a normal distribution test, we use the Jarque-Bera test statistics. We have already explained the Jarque-Bera test in the section above (see section 4.3.1).

Figure 4.7 Normal Distribution Test Result



Source: China Statistics Network (2018), self-elaboration in EViews10

P-value is equal to 0.631, so the model obeys a normal distribution.

4.3.4 Cointegration Test and Long Run Impact

The two commonly used techniques to test for cointegration between variables are the Engle and Granger method and the Johansen technique. The Engle and Granger method is a single-equation technique and as such it can lead to contradictory results, especially when there are more than two cointegrated variables under consideration (Asteriou and Hall, 2011 and Ang, 2010).

The Johansen method, which is known as a system-based approach to cointegration, is considered to be a superior method over the Engle and Granger method, and offers a solution in the case of having more than two variables and multiple cointegration vectors that might exist between the variables. Furthermore, the Johansen approach mitigates the omitted lagged variable bias that affects the Engle and Granger

approach by the inclusion of lags in the estimation. Even so, the Johansen method can be subject to criticism. The first drawback is the sensitiveness of the results to the optimal number of lags included in the test (Gonzalo, 1994). The second is that if there are more than one cointegrating vectors, it is often hard to interpret each implied economic relationship and to find the most appropriate vector for the subsequent test (Ang, 2010).

Both the Engle–Granger and Johansen techniques are criticized on the grounds that the validity of these methods requires that all the variables be integrated of order one, I(1). They cannot be employed, therefore, if we have a mixture of I(0) and I(1) variables.

In this study, we use the ARDL Bounds testing approach to cointegration technique of Pesaran (2001). This method has been used as an alternative cointegration test that examines the long-run relationships and dynamic interactions among the variables and as such addresses the above issues. This approach has several desirable statistical features. First, the cointegrating relationship can be estimated easily using OLS after selecting the lags order of the model. Second, it allows testing simultaneously for the long and short-run relationships between the variables in a time series model. Third, in contrast to the Engle–Granger and Johansen methods, this test procedure is valid irrespective of whether the variables are I (0) or I (1) or mutually co-integrated, which means that no unit root test is required. However, this test procedure will not be applicable if an I (2) series exists in the model. Fourth, in spite of the possible presence of endogeneity, ARDL model provides unbiased coefficients of explanatory variables along with valid *t*-statistics. In addition, Jalil and Ma (2008) and Ang (2010) argue that the ARDL framework includes sufficient numbers of lags to capture the data generating process in *General to Specific* modeling approach of Hendry (1995). Finally, this method of estimation is very efficient and consistent in small and finite sample sizes.

In order to find the long run and short run relationship, the dynamic error

correction model has been used, which derived by ARDL model. The model is presented as follows:

$$\Delta NPLR_t = \alpha_0 + \sum_{i=1}^{p} \theta_i \, \Delta NPLR_{t-i} + \sum_{i=0}^{q_1} \varphi_i \, \Delta UNE_{t-i} + \sum_{i=0}^{q2} \gamma_i \, \Delta M2G_{t-i} + \sum_{i=0}^{q3} \delta_i \Delta INF_{t-i} + \sum_{i=0}^{q4} \zeta_i \Delta GDPG_{t-i} + \sum_{i=0}^{q5} \vartheta_i \, \Delta BLR_{t-i} + \lambda_1 NPLR_{t-1} + \lambda_2 M2G_{t-1} + \lambda_3 INF_{t-1} + \lambda_4 GDPG_{t-1} + \lambda_5 BLR_{t-1} + \varepsilon_t \quad (4.2)$$

Where $\theta, \varphi, \gamma, \delta, \zeta, \vartheta$ are short run parameters and $\lambda_1, \lambda_2, \lambda_3 \lambda_4, \lambda_5$ are long run parameters.

Our model performs well in multiple tests, so we can perform cointegration test, these tests are based on the following assumptions:

H_0: no levels relationship (i.e. no cointegrating relationship)

H_1: levels relationship (i.e. cointegrating relationship)

The calculated F-statistics for the cointegration test are displayed in Tab 4.7:

Table 4.7 Result from Bound Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	7.656690	10%	2.26	3.35
k	5	5%	2.62	3.79
		2.5%	2.96	4.18
		1%	3.41	4.68
Actual Sample Size	56		Finite Sample: n=60	
		10%	2.385	3.565
		5%	2.817	4.097
		1%	3.783	5.338
			Finite Sample: n=55	
		10%	2.393	3.583
		5%	2.848	4.16
		1%	3.928	5.408

Source: China Statistics Network (2018), self-elaboration in EViews10

We see that the F-statistic for our model from the Bounds Test is 7.6567, and this clearly exceeds even the 1% critical value for the upper bound (5.408). Accordingly, we strongly reject the hypothesis of " No level relationship ", therefore there is a cointegrating relationship between NPLR and explanatory variables.

From the test of the cointegration relationship in the previous section, we conclude that the model has a long-run (cointegration) relationship, we can estimate the long run model (levels model), and the long run model can be formulated in the following form:

$$NPLR_t = \omega_1 + \omega_2 UNE_t + \omega_3 M2G_t + \omega_4 INF_t + \omega_5 GDPG_t + \omega_6 BLR_t + \varepsilon_{1t} \quad (4.3)$$

Where, the long run coefficients are calculated as following: $\omega_1 = -\frac{\alpha_0}{\lambda_1}$; $\omega_2 = -\frac{\lambda_2}{\lambda_1}$; $\omega_3 = -\frac{\lambda_3}{\lambda_1}$; $\omega_4 = -\frac{\lambda_4}{\lambda_1}$; $\omega_5 = -\frac{\lambda_5}{\lambda_1}$; $\omega_6 = \lambda_6/\lambda_1$, and ε_{1t} is random error.

The output of the analysis through EViews is:

Table 4.8 Estimated Long Run Coefficients using the ARDL Approach

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNE	-2.905944	6.038912	-0.481203	0.6335
M2G	-1.847863	0.651709	-2.835409	0.0078
INF	0.587524	0.536910	1.094271	0.2818
GDPG	0.769699	0.339697	2.265842	0.0301
BLR	0.529163	0.855568	0.618494	0.5405

Source: China Statistics Network (2018), self-elaboration in EViews10

Indicating long results of ARDL model, we find confirmed that there is a negative and significant relationship between NPLR and M2G at 1% level of significance, it employs that if we increase 1% in M2G in this response there will be a decrease of 1.847863% in NPLR. This is consistent with our theoretical part. And we find confirmed that there is a positive and significant relationship between NPLR and GDPG at 5% level of significance, it employs that if we increase 1% in GDPG in this response there will be an increase of 0.769699% in NPLR. This result is also in line with existing economic theories, Other variables are not significant at 95% confidence level.

4.3.5 Short Run Impact and Adjustment

To estimate the short run relationship, the conventional error correction model version model from the ARDL model in formula 4.2 is used:

$$\begin{aligned}\Delta NPLR_t = \alpha_2 &+ \sum_{i=1}^{p} \theta_{2i}\, \Delta NPLR_{t-i} + \sum_{i=0}^{q_1} \varphi_{2i}\, \Delta UNE_{t-i} \\ &+ \sum_{i=0}^{q2} \gamma_{2i}\, \Delta M2G_{t-i} + \sum_{i=0}^{q3} \delta_{2i} \Delta INF_{t-i} \\ &+ \sum_{i=0}^{q4} \zeta_{2i} \Delta GDPG_{t-i} + \sum_{i=0}^{q5} \vartheta_{2i}\, \Delta BLR_{t-i} + \psi ECM_{t-1}\end{aligned} \tag{4.4}$$

The coefficient of the error correction term (ECM_{t-1}) in formula 4.4 is the speed

of adjustment from the short-run to the long-run (Li, 2017), which is expected to be negative and statistically significant.

In the short-run impact, we can see from the formula 4.4 that the short-run impact results actually show the effect of the increment of each independent variable on the increment of the NPLR.

The output of the analysis through EViews is:

Table 4.9 Error Correction Representation for the Selected ARDL Model

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.568481	0.250812	6.253606	0.0000
D(NPLR(-1))	-0.245024	0.099317	-2.467099	0.0190
D(UNE)	-2.403099	1.306071	-1.839946	0.0748
D(M2G)	-0.099773	0.031732	-3.144224	0.0035
D(M2G(-1))	0.154760	0.035218	4.394300	0.0001
D(M2G(-2))	0.086079	0.030658	2.807694	0.0083
D(INF)	0.045955	0.077991	0.589234	0.5597
D(INF(-1))	-0.042770	0.074749	-0.572186	0.5711
D(INF(-2))	0.086494	0.069492	1.244664	0.2220
D(INF(-3))	-0.336773	0.069244	-4.863549	0.0000
D(GDPG)	0.365938	0.080485	4.546661	0.0001
D(GDPG(-1))	-0.223909	0.077502	-2.889070	0.0068
D(GDPG(-2))	-0.079176	0.067588	-1.171459	0.2498
D(GDPG(-3))	0.282460	0.068185	4.142554	0.0002
D(BLR)	0.104168	0.301386	0.345630	0.7318
D(BLR(-1))	0.270990	0.282774	0.958328	0.3449
D(BLR(-2))	-0.884342	0.254825	-3.470395	0.0015
CointEq(-1)*	-0.178288	0.024513	-7.273292	0.0000

R-squared	0.839899	Mean dependent var	-0.203214
Adjusted R-squared	0.768275	S.D. dependent var	0.646976
S.E. of regression	0.311441	Akaike info criterion	0.759876
Sum squared resid	3.685821	Schwarz criterion	1.410882
Log likelihood	-3.276523	Hannan-Quinn criter.	1.012269
F-statistic	11.72646	Durbin-Watson stat	2.105669
Prob(F-statistic)	0.000000		

Source: China Statistics Network (2018), self-elaboration in EViews10

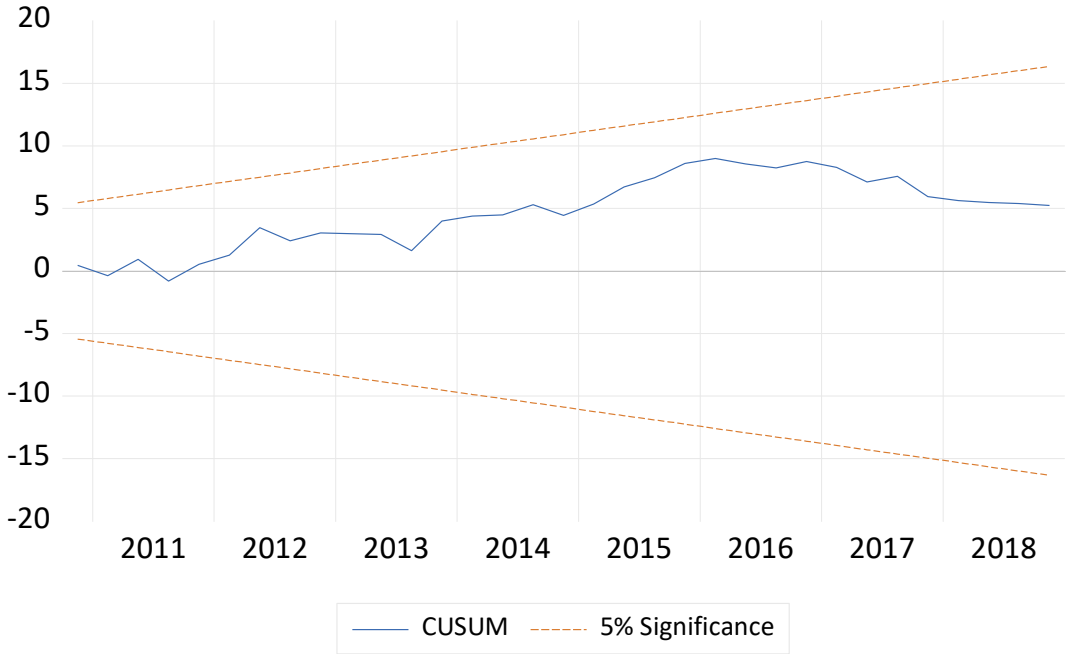
After testing all the cases in this model, we found that the model can get the most realistic estimation results when it is set to *Unrestricted Constant and No Trend*. The coefficient of ECM (CointEq (-1) = -0.1782)) is negative and very significant, which suggests that nearly 17.8288% of any deviation from the long-run equilibrium is

corrected within one period (quarter). Our adjusted R-squared data is very high, indicating that the model has a high degree of fit and prob(F-statistic) is equal to 0, this shows that the model is statistically significant. The increase in the UNE is not significant at the level of significance of 5%. The increment of M2G is still significantly positive after two periods of lag, but as the lag period increases, the coefficient of the increment of M2G decreases, that is, the positive influence gradually weakens. The increment in INF is significant at the level of significance of one percent after three lags. This shows that the increase in INF in the short term will lead to a decline in the NPLR. In the short term, the increase in GDPG will lead to a decrease in NPLR, but with the extension of the lag period, the effect of the increase in GDPG is positive, which is consistent with the long-term positive relationship. The increment in BLR was significantly positive after two periods of lag, indicating that in the short term, the increase in BLR will lead to a decline in the NPLR.

4.3.6 Stability Test

Graphical representations of CUSUM and CUSUM squares are shown in Fig.4.8 and 4.9 for the ARDL model. According to Bahmani and Oskooee (2004) the null hypothesis (i.e. that the regression equation is correctly specified) cannot be rejected if the plot of these statistics remains within the critical bounds of the 5% significance level.

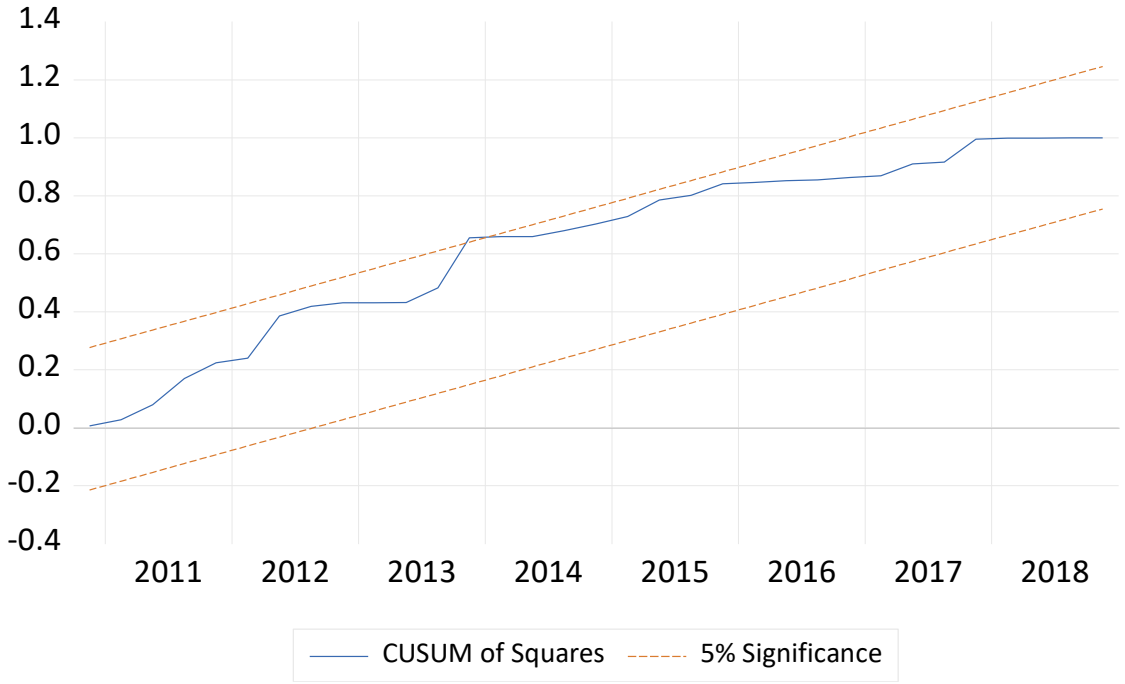
Figure 4.8 Plot of Cumulative Sum of Recursive Residuals



Source: China Statistics Network (2018), self-elaboration in EViews10

From the Fig. 4.8 and 4.9 we can see the CUSUM and CUSUM squares remain within the critical boundaries for the 5% significance level. These plots confirm that the long-run coefficients and all short-run coefficients in the error correction model are stable. That from Fig 4.9 the CUSUM squares approaches boundary between 2013-2014, this shows that the model may not be very stable, and there is the possibility of optimization.

Figure 4.9 Plot of Cumulative Sum of Squares of Recursive Residuals



Source: China Statistics Network (2018), self-elaboration in EViews10

4.4 Robustness Checks

Although the previous model has passed all diagnostic and stability tests successfully, from Fig 4.9 we can see that the curves of the two figures are a little upward offset. Because our data collection period is from the first quarter of 2004 to the fourth quarter of 2018, during this period, the global financial crisis broke out, which has a great impact on the global economy, and between 2008 and 2009, the four major asset management companies were involved in the management of non-performing loans of the four major banks. Therefore, this thesis conducted a Chow test for all possible time points during the financial crisis times.

The important assumption of any time series model is that the underlying process is the same across all observations in the sample. It is, therefore, necessary to analyze carefully time series data that include periods of violent change. A tool that is relatively easy and have some constraints in this regard is the Chow test.

The Chow test is commonly used to test for structural change/break in some or all

of the parameters of a model in cases where the disturbance term is assumed to be the same in both periods.

In this thesis, we get the most suitable time breakpoint after doing the Chow test at all time points during the financial crisis. Results are as follows:

Table 4.10 Chow Test Result

Chow Breakpoint Test: 2008Q4
Null Hypothesis: No breaks at specified breakpoints
Varying regressors: All equation variables
Equation Sample: 2004Q1 2018Q4

F-statistic	140.0575	Prob. F(6,48)	0.0000
Log likelihood ratio	175.0895	Prob. Chi-Square(6)	0.0000
Wald Statistic	840.3448	Prob. Chi-Square(6)	0.0000

Source: China Statistics Network (2018), self-elaboration in EViews10

The Chow test result shown in Tab 4.10 confirms the structural break in the data during the fourth quarter of 2008. The null hypothesis of no break at specified break point (2008Q4) is rejected at 1% level.

Based on the result of the Chow test, we create a dummy variable (DUM) for the model to eliminate the impact of structural break. DUM takes 0 in 2004Q1 to 2008Q3 and 1 in 2008Q4 to 2018Q4.

We re-estimate the model after added the DUM, the output results and test results of the ARDL model are shown in Tab 4.11.

Table 4.11 Estimation Result of ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
NPLR(-1)	0.285614	0.078671	3.630485	0.0010
NPLR(-2)	0.131013	0.090898	1.441319	0.1599
NPLR(-3)	-0.130416	0.075965	-1.716799	0.0963
NPLR(-4)	0.207113	0.057793	3.583687	0.0012
UNE	-1.136198	1.002105	-1.133811	0.2659
UNE(-1)	0.577597	1.122804	0.514424	0.6107
UNE(-2)	-0.335314	1.064285	-0.315061	0.7549
UNE(-3)	1.765095	0.998029	1.768582	0.0871
M2G	-0.026677	0.029919	-0.891661	0.3797
M2G(-1)	-0.023408	0.024998	-0.936398	0.3565
M2G(-2)	-0.055932	0.027336	-2.046070	0.0496
INF	-0.005876	0.059378	-0.098963	0.9218
INF(-1)	-0.128149	0.075451	-1.698440	0.0998
INF(-2)	0.287201	0.072080	3.984474	0.0004
INF(-3)	-0.076922	0.062136	-1.237970	0.2253
GDPG	0.208330	0.061354	3.395542	0.0019
GDPG(-1)	-0.292151	0.061899	-4.719805	0.0001
GDPG(-2)	0.107643	0.066060	1.629478	0.1137
GDPG(-3)	0.072151	0.071102	1.014752	0.3183
GDPG(-4)	-0.184675	0.055164	-3.347769	0.0022
BLR	-0.036774	0.230527	-0.159522	0.8743
BLR(-1)	0.198115	0.345696	0.573092	0.5709
BLR(-2)	-0.826615	0.315702	-2.618337	0.0137
BLR(-3)	0.549199	0.203523	2.698458	0.0113
DUM	-2.901826	0.332011	-8.740148	0.0000
C	1.516387	2.139596	0.708726	0.4840

R-squared	0.997220	Mean dependent var	3.012143
Adjusted R-squared	0.994904	S.D. dependent var	2.826491
S.E. of regression	0.201773	Akaike info criterion	-0.058932
Sum squared resid	1.221367	Schwarz criterion	0.881409
Log likelihood	27.65011	Hannan-Quinn criter.	0.305636
F-statistic	430.5107	Durbin-Watson stat	2.388783
Prob(F-statistic)	0.000000		

Source: China Statistics Network (2018), self-elaboration in EViews10

From the estimation results of the ARDL model, we can see that the adjusted R-squared is equal to 0.995. the model has a high degree of fit. Our model's Prob(F-statistic) is equal to 0, the model is statistically significant and the model is very good. Dummy variable (DUM) is significant at 1% significance level (see section 4.3.3).

Next, we carry out various tests on the new model. The test results are as follows (see Tab 4.12).

Table 4.12 ARDL Model Diagnostic Test

Serial correlation LM test				
F-statistic	1.364677	Prob. F(2,28)	0.2719	(No autocorrelation)
Jarque-Bera test				
F-statistic	0.300352	Probability	0.86056	(Normal distribution)
Heteroskedasticity Test				
F-statistic	1.733808	Prob. F(25,30)	0.0751	(homoskedasticity)

Source: China Statistics Network (2018), self-elaboration in EViews10

It can be seen from Tab 4.12 that the model passed all diagnostic tests at a confidence level of 95% (see section 4.3.3).

Bounds test can be performed after passing all diagnostic tests, Tab 4.13 shows the results of the bounds test:

Table 4.13 Result from Bound Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	38.07699	10%	2.26	3.35
k	5	5%	2.62	3.79
		2.5%	2.96	4.18
		1%	3.41	4.68
Actual Sample Size	56	Finite Sample: n=60		
		10%	2.385	3.565
		5%	2.817	4.097
		1%	3.783	5.338
		Finite Sample: n=55		
		10%	2.393	3.583
		5%	2.848	4.16
		1%	3.928	5.408

Source: China Statistics Network (2018), self-elaboration in EViews10

We see that the F-statistic for our model from the Bounds Test is 38.07699, therefore there is a cointegrating relationship between NPLR and explanatory variables (see section 4.3.4).

After the model passes the cointegration test, we can discuss the long-term and

short-term effects of the new model.

The output of EViews is shown in Tab 4.14 and 4.15:

Table 4.14 Estimated Long Run Coefficients using the ARDL Approach

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNE	1.719404	1.211203	1.419585	0.1660
M2G	-0.209242	0.117722	-1.777433	0.0856
INF	0.150498	0.106088	1.418615	0.1663
GDPG	-0.175068	0.096161	-1.820584	0.0787
BLR	-0.229090	0.178522	-1.283260	0.2092

Source: China Statistics Network (2018), self-elaboration in EViews10

Table 4.15 Error Correction Representation for the Selected ARDL Model

ECM Regression
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.516387	0.153684	9.866942	0.0000
D(NPLR(-1))	-0.207710	0.058210	-3.568300	0.0012
D(NPLR(-2))	-0.076696	0.058906	-1.302024	0.2028
D(NPLR(-3))	-0.207113	0.050357	-4.112854	0.0003
D(UNE)	-1.136198	0.805473	-1.410597	0.1686
D(UNE(-1))	-1.429781	0.862675	-1.657380	0.1079
D(UNE(-2))	-1.765095	0.815666	-2.163994	0.0386
D(M2G)	-0.026677	0.016489	-1.617869	0.1162
D(M2G(-1))	0.055932	0.016077	3.479120	0.0016
D(INF)	-0.005876	0.047864	-0.122767	0.9031
D(INF(-1))	-0.210279	0.047421	-4.434308	0.0001
D(INF(-2))	0.076922	0.045873	1.676862	0.1040
D(GDPG)	0.208330	0.042014	4.958542	0.0000
D(GDPG(-1))	0.004881	0.040490	0.120554	0.9048
D(GDPG(-2))	0.112524	0.039183	2.871798	0.0074
D(GDPG(-3))	0.184675	0.044847	4.117932	0.0003
D(BLR)	-0.036774	0.184921	-0.198864	0.8437
D(BLR(-1))	0.277415	0.183882	1.508658	0.1418
D(BLR(-2))	-0.549199	0.163090	-3.367471	0.0021
DUM	-2.901826	0.225580	-12.86387	0.0000
CointEq(-1)*	-0.506676	0.031035	-16.32602	0.0000

R-squared	0.946947	Mean dependent var	-0.203214
Adjusted R-squared	0.916632	S.D. dependent var	0.646976
S.E. of regression	0.186805	Akaike info criterion	-0.237504
Sum squared resid	1.221367	Schwarz criterion	0.522003
Log likelihood	27.65011	Hannan-Quinn criter.	0.056955
F-statistic	31.23614	Durbin-Watson stat	2.388783
Prob(F-statistic)	0.000000		

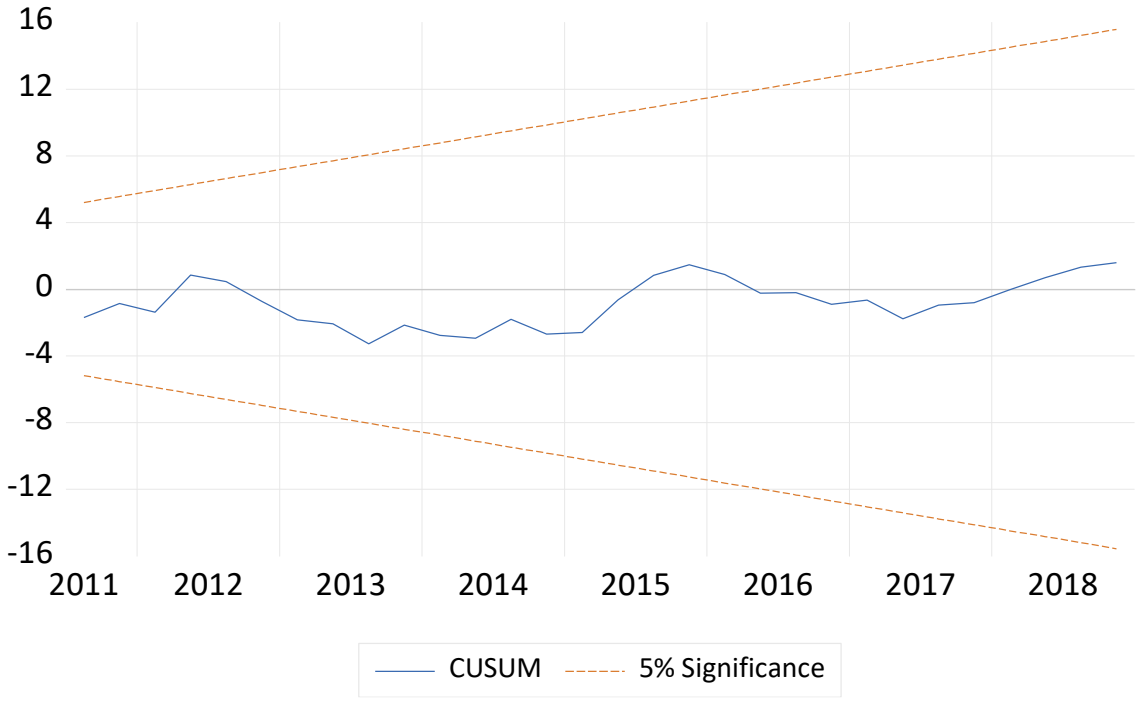
Source: China Statistics Network (2018), self-elaboration in EViews10

From the cointegration model, it can be seen that in the long run, the increase in GDPG will lead to a decline in the NPLR, and the increase in the M2G will cause the NPLR to decline, this still conforms to the existing economic theory. At 90% confidence level, if M2G increases by 1%, NPLR will decrease by 0.209%. If GDPG increases by 1%, NPLR will decrease by 0.175% (see section 4.3.4).

The Adjusted R-squared of the error correction model is larger than the error correction model without the dummy variable, which indicates that the dummy variable plays a good role in adjusting the model. The coefficient of ECM (CointEq (-1) = -0.5067)) is negative and very significant, which suggests that nearly 50.667% of any deviation from the long-run equilibrium is corrected within one quarter. The adjustment speed of the original model is 17.8288%, we found that the adjustment speed increased dramatically after adding DUM. The UNE increment is not significant, but it is significantly negative after two periods, indicating that the UNE increase will lead to a decrease in NPLR after two periods of lag. The increment of M2G is significantly positive after the first period of lag, indicating that the increase of M2G will lead to an increase in NPLR in the short run. The increment of INF is significantly negative after the first period of lag, indicating that the increase in INF will lead to an increase in NPLR in the short term. The coefficient of GDPG increment is significantly negative, and the coefficient is still significantly positive after two and three periods of lag, indicating that the increase in GDPG in the short term will lead to an increase in NPLR. The BLR increment is significantly negative after two periods of lag, indicating that an increase in BLR in the short term will result in a decrease in NPLR (see section 4.3.5).

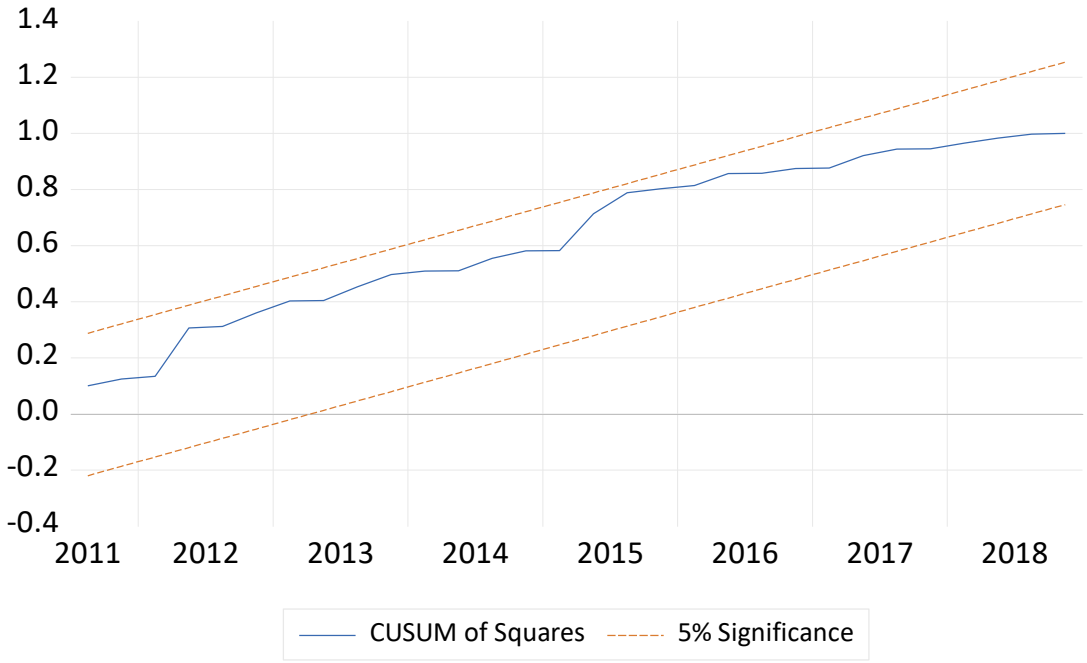
The final step is the Stability testing. The output of EViews is as follows:

Figure 4.10 Plot of Cumulative Sum of Recursive Residuals



Source: China Statistics Network (2018), self-elaboration in EViews10

Fig 4.11 Plot of Cumulative Sum of Squares of Recursive Residuals



Source: China Statistics Network (2018), self-elaboration in EViews10

From the Fig. 4.10 and 4.11 we can see the CUSUM and CUSUM squares remain within the critical boundaries for the 5% significance level. And after adding the dummy variable, the problem of the curve slightly shifting upward is basically solved. The new model is more stable than the original model (see section 4.3.6).

5 Conclusions

The aim of this thesis is investigating the impact of macroeconomic factors on the non-performing loans ratio of Chinese commercial banks. So, this thesis builds a model based on the ARDL model framework, and estimates the long-run and short-run effects of macroeconomic factors on non-performing loans through the econometric tool "EViews10".

The conclusion can be made through combing with existing economic theory and empirical analysis: the increase in the money supply in the short run will lead to an increase in the non-performing loans ratio, because the loose monetary policy will be adopted when the economy is in a downward stage, and increasing the money supply, thus making commercial banks expand the scale of loans. However, while the business environment is tightening and profitability is declining, the demand for financing will drop and the ability to repay loans will be affected to some extent, which will lead to a decline in the credit quality of some banks and a corresponding rise in non-performing loans ratios. In a short run, inflation will reduce the non-performing loans ratio which also conforms to demand-driven inflation theory. Short-run economic growth will lead to an increase in non-performing loans ratios, because as the economy overheats, the state will implement macro-control to regulate the economic fluctuation, the People's Bank of China will tighten liquidity, and the non-performing loans ratio will rise.

Among the long-term effects, only the money supply growth rate and the GDP growth rate are significant. An increase in the growth rate of money supply will lead to a decrease in non-performing loans ratio, because that the monetary policy will affect the economy through interest rate mechanism and the increase in money supply will lead to a drop in interest rates in the long run, thus stimulating an increase in investment and eventually increasing national income. As a result, the interest rate transmission mechanism of monetary policy will weaken its positive effect on the non-performing loans ratio, finally, reducing the non-performing loans ratio. In the long run, there is a

negative relationship between the economic growth and the non-performing loans ratio. With the economic growth, the non-performing loans ratio is declining, which means that the overall loan quality of China's commercial banks will be improved when the economy is in an upward stage, and the money lent by commercial banks will be well used for infrastructure construction and enterprise investment, so as to improve national income.

In order to strengthen the credit risk management of commercial banks and in view of the current economic situation in China, the management of commercial banks should be strengthened and the credit risk management capabilities should also be promoted. Banks should have enough understanding of the development prospects, profit margins and competitive environment of the loan delivery industry, and be able to strategically select the direction of business development to prevent systemic risks brought about by macroeconomic fluctuations. Besides, the rationality and effectiveness of monetary policy implementation should be enhanced.

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List of Abbreviations

NPLs	Non-performing Loans
NPLR	Non-performing Loan Ratio
GDP	Gross Domestic Product
ECB	European Central Bank
IMF	International Monetary Fund
CBRC	China Banking Regulatory
PCR	Provision Coverage Ratio
DRR	Deposit Reserve Ratio
SMEs	Small and Medium Enterprises
OPEC	Organization of Petroleum Exporting
ARDL	Autoregressive Distributed Lag Model
UNE	Unemployment Rate
INF	Inflation Rate
M2G	Nominal Money Supply Growth Rate
BLR	Bank Lending Rate
GDPG	Gross Domestic Product Growth Rate
AIC	Akaike Information Criteria
ADF	Augmented Dickey–Fuller Test
PP	Phillips--Perron Test

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Ostrava dated 26.04.2019

Dong Wei 魏冬

Student's name and surname

List of Annexes

Annex 1: Inflation Rate, Non-performing Loan Ratio and Unemployment Rate (unit: percentage) (2004Q1-2008Q4)

TIME	inflation rate(%)	Non-performing loan ratio(%)	unemployment rate
2004-Q1	2.77	16.6	4.3
2004-Q2	4.4	13.32	4.3
2004-Q3	5.27	13.37	4.2
2004-Q4	3.17	13.21	4.2
2005-Q1	2.83	12.4	4.2
2005-Q2	1.73	8.71	4.2
2005-Q3	1.33	8.58	4.2
2005-Q4	1.37	8.61	4.2
2006-Q1	1.2	8.03	4.2
2006-Q2	1.37	7.53	4.2
2006-Q3	1.27	7.33	4.1
2006-Q4	2.03	7.09	4.1
2007-Q1	2.73	6.63	4.1
2007-Q2	3.6	6.45	4.1
2007-Q3	6.1	6.17	4
2007-Q4	6.63	6.17	4
2008-Q1	8.03	5.78	4
2008-Q2	7.77	5.58	4
2008-Q3	5.27	5.49	4
2008-Q4	2.53	2.42	4.2
2009-Q1	-0.6	2.04	4.3
2009-Q2	-1.53	1.77	4.3
2009-Q3	-1.27	1.66	4.3
2009-Q4	0.67	1.58	4.3
2010-Q1	2.2	1.4	4.2
2010-Q2	2.93	1.3	4.2
2010-Q3	3.47	1.2	4.1
2010-Q4	4.7	1.14	4.1
2011-Q1	5.07	1.1	4.1
2011-Q2	5.73	1	4.1
2011-Q3	6.27	0.9	4.1
2011-Q4	4.6	1	4.1
2012-Q1	3.77	0.94	4.1
2012-Q2	2.87	0.94	4.1
2012-Q3	1.9	0.95	4.1
2012-Q4	2.07	0.95	4.1
2013-Q1	2.43	0.96	4.1
2013-Q2	2.4	0.96	4.1
2013-Q3	2.8	0.97	4
2013-Q4	2.9	1	4.1
2014-Q1	2.3	1.04	4.1
2014-Q2	2.2	1.08	4.1
2014-Q3	1.97	1.16	4.1
2014-Q4	1.5	1.25	4.1
2015-Q1	1.2	1.39	4.1
2015-Q2	1.37	1.5	4.04
2015-Q3	1.73	1.59	4.05
2015-Q4	1.47	1.67	4.05
2016-Q1	2.13	1.75	4.04
2016-Q2	2.07	1.75	4.05
2016-Q3	1.67	1.76	4.04
2016-Q4	2.17	1.74	4.02
2017-Q1	1.4	1.74	3.97
2017-Q2	1.4	1.74	3.95
2017-Q3	1.6	1.74	3.95
2017-Q4	1.8	1.74	3.9
2018-Q1	2.17	1.75	3.89
2018-Q2	1.83	1.86	3.83
2018-Q3	2.29	1.87	3.82
2018-Q4	2.17	1.83	3.8

Source: China Statistics Network (2018)

Annex 2: GDP Growth Rate, M2 Growth Rate and Bank Lending Rate (unit: percentage)

(2004Q1-2008Q4)

TIME	GDP growth rate(%)	m2 growth rate(%)	bank lending rate(%)
2004-Q1	10.6	4.87	5.31
2004-Q2	11.6	3.38	5.31
2004-Q3	9.8	2.08	5.31
2004-Q4	8.8	3.11	5.58
2005-Q1	11.1	5.05	5.58
2005-Q2	11.1	3.88	5.58
2005-Q3	10.8	4.15	5.58
2005-Q4	12.4	3.90	5.58
2006-Q1	12.5	4.53	5.58
2006-Q2	13.7	3.77	5.85
2006-Q3	12.2	3.21	6.12
2006-Q4	12.5	3.26	6.12
2007-Q1	13.8	5.75	6.12
2007-Q2	15	3.78	6.39
2007-Q3	14.3	4.42	6.84
2007-Q4	13.9	2.85	7.29
2008-Q1	11.5	5.39	7.47
2008-Q2	10.9	3.70	7.47
2008-Q3	9.5	3.01	7.2
2008-Q4	7.1	2.88	6.66
2009-Q1	6.4	10.56	5.58
2009-Q2	8.2	8.10	5.31
2009-Q3	10.6	4.68	5.31
2009-Q4	11.9	3.01	5.31
2010-Q1	12.2	6.95	5.31
2010-Q2	10.8	4.30	5.31
2010-Q3	9.9	3.22	5.31
2010-Q4	9.9	3.79	5.56
2011-Q1	10.2	4.32	5.81
2011-Q2	10	3.30	6.31
2011-Q3	9.4	1.72	6.56
2011-Q4	8.8	6.52	6.56
2012-Q1	8.1	5.00	6.56
2012-Q2	7.6	3.67	6.56
2012-Q3	7.5	2.69	6
2012-Q4	8.1	2.43	6
2013-Q1	7.9	6.00	6
2013-Q2	7.6	3.39	6
2013-Q3	7.9	1.97	6
2013-Q4	7.7	2.04	6
2014-Q1	7.4	4.91	6
2014-Q2	7.5	4.24	6
2014-Q3	7.1	0.93	6
2014-Q4	7.2	1.18	6
2015-Q1	7	3.83	5.6
2015-Q2	7	3.87	5.35
2015-Q3	6.9	3.79	4.85
2015-Q4	6.8	1.41	4.35
2016-Q1	6.7	3.87	4.35
2016-Q2	6.7	2.57	4.35
2016-Q3	6.7	2.76	4.35
2016-Q4	6.8	1.79	4.35
2017-Q1	6.9	3.45	4.35
2017-Q2	6.9	1.48	4.35
2017-Q3	6.8	2.09	4.35
2017-Q4	6.8	1.70	4.35
2018-Q1	6.8	3.51	4.35
2018-Q2	6.7	1.18	4.35
2018-Q3	6.5	2.20	4.35
2018-Q4	6.4	1.28	4.35

Source: China Statistics Network (2018)